ENGINEERING DOCTORATE

Supplier Selection using Performance Self Assessment Reporting in the Automotive Industry

Executive Summary

Ian Riggs

December 2004

Contents

List of Figures

List of Tables

List of Appendices

Acknowledgements

In undertaking this research doctorate I knew that I would need the help and support of many individuals, in many ways, if I were to make a success of it. And so it proved to be.

Firstly, I must thank Paul Roberts, Principal Fellow at Warwick Manufacturing Group, who has been my academic mentor during the course of my research. He has helped shape this work, challenging my ideas, and making the end result all the better for it.

The research has formed a key part of my work as Group Quality Director at Cosworth Technology Ltd. I must therefore thank Dr Blickle, our first Chief Executive Officer, for the encouragement to begin this study and to Robin Hall, Group Purchasing Manager for allowing me to interfere with his department and for the constructive input that he, and his team, had in the development of this work.

The biggest debt I owe is to my family, Katherine, Thomas and Alexander, who have put up with me being absent most weekends whilst I have read about, thought about or written up this work. I hope that I will be able to make it up to you all.

To all the others, too numerous to mention, I thank you.

Abstract

The automotive industry has adopted the use of third party quality management certification as the main quality approval mechanism for its supply base. In addition, most organisations have a system of supplier monitoring to measure their existing supplier's performance and this approach makes it difficult for suppliers to gain new business because their quality capability is unknown to the customer.

Two case studies were conducted to determine whether or not suppliers certified to one of the automotive quality management standards had improved quality performance compared to those with the generic ISO 9001/2 standard. The research concluded that the additional certification requirements and increased costs associated with the automotive standards resulted in no quality benefit. Furthermore, a third case study using second party quality assessment results demonstrated that there was no correlation between these audit results and achieved quality performance.

Therefore the research set out to answer the question :

How can the current supplier selection practices used within the automotive industry be improved to ensure effective decision-making?

The Supplier Performance Evaluation Datasheet (SPED) process was developed from a synthesis of current practice and input from industry experts. It incorporates adaptations of best practices in non-quality assessment methods. Three key elements of the SPED process are :

- Performance reporting
- Minimum performance standards
- Stakeholder engagement

The proposed process was evaluated through two case studies at Cosworth Technology Ltd and from an expert opinion survey of industry experts in the field of supplier management.

The conclusion of this study was that the SPED process would enable customers to select new suppliers with high levels of confidence. It would add value to all organisations taking part and it is easy to implement.

Glossary of Terms

Benchmarking

Benchmarking is a process of comparing the performance of different organisations to establish best practice.

Certification bodies

A certification body is an organisation that has been accredited to conduct third party certification audits to specific standards.

Compliance standards

This type of standard requires an organisation to demonstrate that its processes and procedures comply with the requirements of the relevant standard. An example of this type of standard is ISO 9001 : 1994.

Cross functional team

The term 'cross functional team' is used extensively within the automotive industry and refers to a team made up of members from different functions of the business, brought together to achieve a specific goal.

First Party Assessment

This refers to the 'internal audit' of an organisation to the requirements of a specified quality management standard.

Globalisation

The globalisation of the automotive industry has seen the major Vehicle Manufacturers establish production facilities and sales networks on every continent. The consequence has been for many major tier one suppliers to

follow suit and establish their own facilities to support the Vehicle Manufacturers.

Likert scale

This is a rating scale typically used in research questionnaires that allow participants to indicate their level of agreement with statements defined by the researcher.

Parts per million (PPM)

PPM is a method of stating the performance of a process in terms of actual non-conforming material. This is the normal unit of measure for quality rejects within the automotive industry. It represents the number of parts that would be rejected per one million components supplied based on actual data.

Performance metrics

Performance metrics or key performance metrics are measures of performance within an organisation, which indicate the status of the business in meeting its objectives. Examples include :

- Profit margins
- Scrap levels
- Rework levels
- Process efficiency
- Process capability

Performance standards

This type of standard requires an organisation to achieve specified levels of performance as opposed to demonstrating compliance to requirements. An example of this type of standard is the corporate social responsibility standard, SA 8000.

Portfolio

This refers to the collection of research reports and documents related to the projects and taught modules undertaken by the research engineer to meet the requirements of the Engineering Doctorate (Eng.D) programme.

Portfolio submission

A portfolio submission refers to individual research reports or documents submitted as part of the Eng.D portfolio.

Powertrain

Within the automotive industry 'powertrain' refers to the engine and its related components.

Process capability

Process capability refers to the statistical analysis of the output of a production process to determine its ability to product parts within the stated specification.

Quality capability

The quality capability of a supplier refers to the ability of the organisation to meet the stated and implied needs of the customer related to the quality of the product and / or service.

Second party assessment

This refers to a customer assessment of a new or existing supplier using an appropriate quality standard.

Self-assessment

This refers to an organisation's own internal process to assess its performance. The term self-assessment has also become synonymous with the assessment of an organisation to the Business Excellence Model.

Stakeholders

The term stakeholder refers to any individual or group affected by the actions of an organisation. Typically these include customers, suppliers, employees, local communities, financial institutions, shareholders and government.

Stakeholder engagement

Stakeholder engagement is a process that enables stakeholders to provide feedback on the performance of the organisation as experienced by the stakeholder.

Supplier assessment

Supplier assessment refers to the assessment of a supplier organisation by a third party certification body.

Supplier evaluation

Supplier evaluation refers to the assessment of a supplier's performance by the customer, usually through a system of planned visits or audits.

Ian Riggs

Warwick Manufacturing Group
University of Warwick

Supplier rating

Supplier rating is the ongoing supplier performance monitoring process, usually concerning quality and delivery performance and is used to measure the performance of existing suppliers to the organisation.

Supplier sourcing

This is the process of nominating a supplier for a new contract.

System or module suppliers

Systems or modules refer to a group of components that represent a specific function within a vehicle and which are supplied by one supplier. Typical examples are engines, seating, windscreen wipers, etc.

Third party certification

This refers to an assessment process, which is conducted by an accredited, independent organisation to the requirements of a defined standard.

Tier 0.5 suppliers

Another term for system or module suppliers and is meant to reflect their close integration into the customer's organisation.

Tier one suppliers

Tier one suppliers are those suppliers that provide products directly to the Vehicle Manufacturer or Original Equipment Manufacturer.

Vehicle Manufacturer (VM)

This refers to car manufacturers who assemble the finished vehicle and includes brands such as Ford, GM, Toyota, Honda, etc.

1.0 Introduction

1.1 Project Introduction

The idea for the research topic was borne out of the researcher's own experience of the use of third party certification within the automotive industry.

During the 1990s the automotive industry shifted away from second party assessments (customer audits) to the use of third party assessment by approved certification bodies.

For the supply base this was initially seen as a positive move as the second party assessment process was often perceived as biased or subject to 'political decision making' (Riggs, 1997). Other industries had already accepted third party certification for supplier approval using the international quality management standard ISO 9001, launched in 1987 (or BS 5750 in the UK since 1979).

The success of ISO 9001 lay with its generic applicability to any industry and the benefit of avoiding the need for multiple customer assessments. The automotive industry was suspicious of this standard and its effectiveness at ensuring 'good quality products' (Hoyle, 1996). Therefore in the mid 1990s the automotive industry developed its own quality management standards with prescriptive requirements and onerous auditor qualification processes. For example QS 9000, the standard developed by Ford, General Motors and Chrysler consisted of seven manuals to which the supplier had to demonstrate compliance (AIAG, 1995). VDA, the German automotive

equivalent, had 9 requirement manuals (VDA6.1, 1998). Both QS 9000 and VDA6.1 included ISO 9001 in full within their requirements.

The aim of these standards is to ensure that the supplier's quality management system enables them to meet the quality targets set by the Vehicle Manufacturers (VMs) and to establish continuous improvement processes leading to cost reductions. The automotive suppliers had to absorb the cost of certification and ensure that the prescriptive requirements were included within their quality management systems.

Another impact of the new standards was that tier one organisations became responsible for cascading the certification process down the supply chain. Organisations are encouraged to specify third party certification as a prerequisite for supplier approval and to disband their own second party assessment activities (AIAG, 1995).

As a Quality Executive with fifteen years experience in the automotive industry the researcher had seen first hand the variability of quality performance amongst QS 9000 / VDA certified suppliers. However from a search of the literature there appeared to be little documented evidence to quantify or verify this observation. One reason for this may be the fact that many organisations depend upon the perpetuation of this approach for their livelihood (Seddon, 2000).

Most organisations have a system of supplier monitoring to measure their existing supplier's performance and therefore they are in a position to make informed decisions based on this 'historical experience'. However this

approach can limit the number of available suppliers to the organisation because of the perceived risk of awarding a contract to an 'unknown' supplier. In this context the 'unknown factor' is the quality capability of the supplier. With the development of low cost production facilities in Eastern Europe, Asia and South America there are opportunities for organisations to lower the cost of their materials, components and systems provided that the supplier can meet their quality and delivery expectations.

The aim of the research will be to define a reliable, low cost process for determining the quality capability of an organisation and to use this process as part of supplier sourcing decision-making within the automotive industry.

The research question is defined as :

How can the current supplier selection practices used within the automotive industry be improved to ensure effective decision-making?

The research objectives are :

i) To critically evaluate the current practices of supplier selection and approval within the automotive industry and identify opportunities for improvement. In particular the research shall evaluate the role of 2nd and 3rd party assessment in supplier selection.

ii) To evaluate other certification and assessment schemes to identify best practice

iii) To establish a robust, reliable, and cost effective process for supplier selection that can be used within the automotive industry to support the industry's global purchasing strategies.

iv) To evaluate the proposed supplier selection process by using it in real sourcing decisions and by conducting a survey of industry experts.

1.2 Main Themes

The central theme of this project is the quality evaluation of potential suppliers in the automotive industry. The main process for quality evaluation is now through automotive industry quality management standards using the third party certification approach. The stated benefits of these industry standards have been (AIAG, 1998 : Johnson, 2001):

- Improved quality e.g. reduced Parts per Million (PPM)
- Improved efficiency, and
- Improved delivery

The automotive standards evaluated as part of this research are :

a) QS 9000

This standard was developed by Ford, General Motors and Chrysler (also known as 'the big three') and was first published in the US in 1994 and the rest of the world in 1995. It is assessed through approved third party certification bodies and is based on the 1994 version of ISO 9001. The

standard is due to expire in 2006 when it will be replaced by ISO / TS 16949 : 2002.

b) VDA6.1

This is the German VMs equivalent of QS 9000. Like QS 9000 it is based on ISO 9000 and is assessed through third party certification bodies. This standard is also due to expire in 2006 and will be replaced by ISO / TS 16949 : 2002.

c) ISO / TS 16949 : 1999

This standard was launched in 1999 and was developed to harmonise the requirements of QS 9000 and VDA6.1 along with the requirements of all the other major VMs. In practice there is very little difference to the requirements of QS 9000. This standard will expire in mid 2004 and will be replaced by ISO / TS 16949 : 2002.

d) ISO / TS 16949 : 2002

This version of the standard was updated to meet the requirements of ISO 9001 : 2000. Although the structure of the standard is very different, many of the actual requirements are carried over from the previous standard.

To evaluate the effectiveness of the automotive standards it is important to analyse the requirements of the standard as well as the assessment methods used. The research has also evaluated the auditor competence requirements.

'Effectiveness' in this context means the ability of the standard to deliver improved quality performance compared to the generic ISO 9000 series of

standards and to ensure that approved companies meet automotive quality targets (measured in PPM). The approach of these standards has also been benchmarked against the requirements of other quality certification standards in other industries including aerospace (AS 9100) and telecommunications (TL 9000). In addition the requirements of customer specific quality awards such as Ford's Q1 Award were evaluated along with International Business Excellence Awards, the European Business Excellence Award, the Malcolm Baldridge Award (USA) and the Deming Prize (Japan).

The research recognised that the third party approach had replaced a well-established program of second party assessment conducted by the VMs. Therefore within the research it was also important to evaluate the effectiveness of 2nd party assessment compared to that of 3rd party assessment. One of the last remaining major second party assessment programs is carried out by Volkswagen to the requirements of VDA6.3 (Process Auditing). A study was conducted to evaluate the success of this approach in determining the quality capability of the assessed suppliers.

Non-quality certification schemes were also evaluated. These included the Environmental schemes of BS 7750, ISO 14001 and the Eco-management and Audit Scheme (EMAS) as well as the Corporate Social Responsibility standards AA 1000, SA 8000 and the Global Reporting Initiative (GRI).

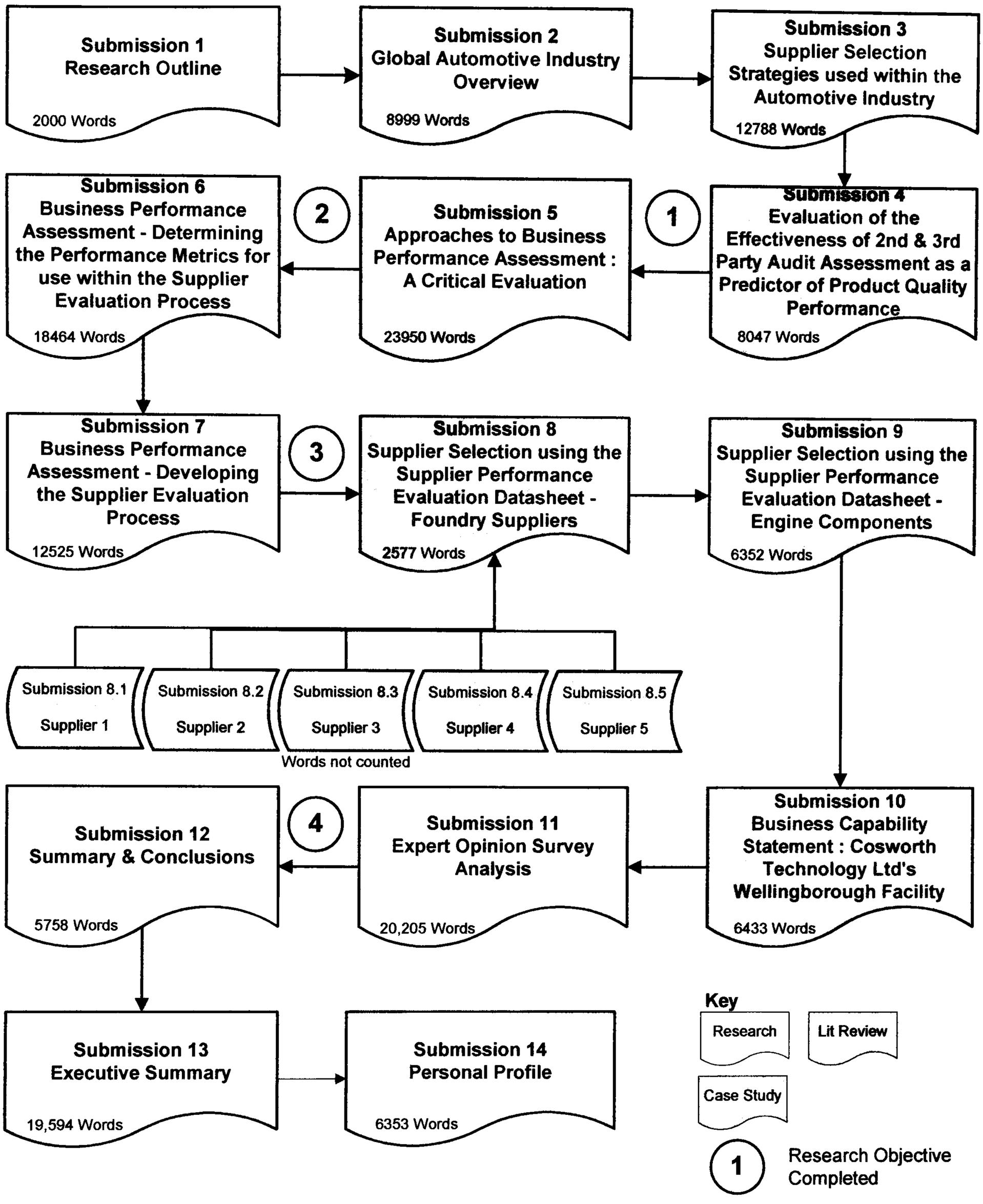
The second theme in the project is related to the Supplier Sourcing process in the automotive industry and in particular its use of third party certification as a pre-requisite for supplier acceptance. One of the expected benefits of the use of common third party assessment within the automotive industry was the

ability of organisations to select 'approved suppliers' knowing that they would have the necessary systems in place to manage the quality of their processes and products. The implication of this is that these certified suppliers would meet the expected automotive quality targets.

It should be noted that the use of quality management systems to ensure the quality of processes and products is very much a Western view and not one that is held by the Japanese VMs. Instead they believe in 'kaizen' or 'the systematic improvement of everything' and will invest heavily in engineering support to ensure that their key suppliers are able to meet their ongoing quality, delivery and cost requirements (Richmond, 2002). The Japan Automobile Manufacturers Association (JAMA) has taken part in the development of the latest version of ISO / TS 16949 : 2002 although its motives are to ensure that Japanese suppliers are qualified to export to the Western VMs (Seddon, 2004 : Bird, 2004).

1.3 Structure of the Project

The Engineering Doctorate (Eng.D) Portfolio has been developed in what is referred to as a 'book structure'. It is laid out in chapters and follows a highly structured format. The submissions were written and submitted, in order, as the project developed. Figure 1 shows the portfolio structure and the interrelationship of each submission: The reading order is also indicated. This structure was chosen because of the strong central themes running throughout the project.



Total Words : 154,045

Figure 1 : Portfolio Structure, Word Count & Reading Order

Ian Riggs

Warwick Manufacturing Group
University of Warwick

1.4 Submission Overviews

This chapter shall provide an overview of each portfolio submission to enable the reader to understand its purpose, scope and key achievements.

1.4.1 Submission 1 :

Research Outline

Purpose :

The objective of this submission is to define the project themes and research questions, the intended methodologies and to establish a preliminary project milestone plan.

Overview :

This submission provided a high level overview of the automotive industry's approach to the use of third party certification and a critical evaluation of the achieved results of this approach. The preliminary literature review in this submission enabled the researcher to focus on the intended subject for the project and develop a set of research questions, which would be evaluated during the course of the project. This in turn enabled the development of a portfolio plan, an initial evaluation of potential research methodologies and a preliminary milestone plan.

The submission was used to 'frame' the research proposal and therefore enabled the researcher to gain approval for the work from the University and the sponsoring organisation, Cosworth Technology Limited.

1.4.2 Submission 2 :

Global Automotive Industry Overview

Purpose :

The purpose of this submission is to provide a backdrop to the research and describe the key attributes of the automotive industry.

Overview :

The submission describes the history of the automotive industry from its 19th century origins to the present day. In particular the submission describes the current economic and competitive pressures on the industry and how these impact on the whole supply chain.

The submission provides key statistics to describe the current status of the automotive industry and the current trends that affect the whole supply chain.

The submission highlighted three relevant questions regarding the research topic.

1) If organisations have to source materials and components from distant geographical regions in order to deliver cost reductions and remain competitive would they be able to rely on third party certification approval of potential suppliers to ensure quality? An alternative would be for them to re-introduce expensive 2nd party audits (Reid, 1999).

2) With the introduction of system integrators (tier 0.5 suppliers) these companies had to gain additional competence for component manufacture by merging or acquiring other suppliers or find their own source for these

components. If the latter was chosen could the organisation rely on third party certification for supplier selection?

3) The use of on-line auctions is designed to put maximum pressure on the supplier to submit a low quotation to win the business. The key pre-requisite for quality approval of the suppliers taking part is QS 9000 or VDA6.1. Again is this certification reliable in ensuring that the supplier will provide acceptable quality products?

1.4.3 Submission 3 :

Supplier Selection Strategies used within the Automotive Industry

Purpose :

The purpose of this submission is to provide a detailed overview of the supplier selection processes used in the automotive industry. In particular how quality certification (second and third party) is used to approve suppliers.

Overview :

The submission evaluates the supplier evaluation processes of the major VMs including Ford, General Motors, Renault and Volkswagen. It describes the key evaluation criteria used including technical capability, quality, cost, logistic capability and environmental performance. It also compares this approach with other industries such as aerospace and telecommunications as well as other research carried out in the area of supplier selection.

1.4.4 Submission 4 :

Case Study – Evaluation of the Effectiveness of 2nd and 3rd Party Audit Assessment as a Predictor of Product Quality Performance

Purpose :

The purpose of this submission is to establish if there is a correlation between certification to one of the automotive industry quality standards and achieved quality levels (PPM). In addition it sets out to establish if automotive certified suppliers have improved quality performance compared to those with the generic ISO 9001 certification.

Overview :

The case study examines the achieved quality performance of two groups of suppliers. The first group consisted of 71 engine component suppliers to Cosworth Technology Ltd, Wellingborough. The second group consisted of 56 windscreen wiper system component suppliers to Trico Limited, Pontypool.

The performance of suppliers with automotive certification was compared to those with the generic ISO 9000 standards. The case study provided clear evidence that there was no significant performance benefit between the automotive certified suppliers and those with the generic ISO 9000 standard certification.

In addition 71 of the suppliers to Cosworth Technology Ltd were also evaluated using Volkswagen second party assessment ratings to determine whether or not the audit score correlated to the achieved quality performance

of those suppliers. The results of this study showed that second party assessment results did not correlate to achieved quality performance.

1.4.5 Submission 5 :

Approaches to Business Performance Assessment : A Critical Evaluation

Purpose :

The purpose of this submission is to critically analyse the various assessment approaches used throughout industry and to identify best practice.

Overview :

The submission evaluates the development of quality management systems standards from their origins to the current versions in place today. It contrasts and compares the approaches of the generic ISO 9000 series with that of the industry specific standards. It also examines other quality assessment methods such as the European Business Excellence Model, the Malcolm Baldridge Award and the Deming Prize.

This submission also evaluates the environmental management standards of ISO 14001 and the Eco-management and Audit Scheme (EMAS). Finally it reviews the new corporate social responsibility standards of SA 8000, the Global Reporting Initiative (GRI), AA 1000 and the United Nation's Global Compact.

This submission enabled the development of a model to show how the various standards compare. It identified two key areas that could improve the

effectiveness of the current automotive quality management system standards. These are :

1) The establishment of quality performance standards as opposed to 'compliance' standards.

2) The use of stakeholder engagement to verify the performance data reported.

1.4.6 Submission 6 :

Business Performance Assessment : Determining the Performance Metrics for use within the Supplier Evaluation Process

Purpose :

The purpose of this submission is to identify key performance metrics that could be used to establish a 'performance based' assessment process for automotive suppliers.

Overview :

The submission identified a prioritised list of key performance metrics that would form the basis of the performance assessment methodology. It also concluded that this list of metrics could be adapted to suit the needs of the organisation although the 'core' performance indicators would be quality, delivery and efficiency.

Submission 7 :

Business Performance Assessment – Developing the Supplier Evaluation Process

Purpose :

The purpose of this submission is to develop an assessment process, which incorporates the key performance metrics, identified in the previous submission.

Overview :

The submission describes the development of the Supplier Performance Evaluation Datasheet as a tool for supplier evaluation. The evaluation process is designed primarily for automotive tier one and two organisations. The process is intended to assess 'new suppliers' with whom there is no current experience. The evaluation process enables the data to be compared to that of the organisation's existing suppliers and therefore aid the supplier selection decision process. The evaluation method was tested in a pilot study at Cosworth Technology Ltd, Wellingborough and the conclusions were analysed and incorporated into its future application.

Submission 8 :

Case Study Overview– Supplier Selection using the Supplier Performance Evaluation Datasheet at Cosworth Technology Ltd's Worcester Foundry, Aluminium Material Suppliers

Purpose :

The purpose of this submission is to test the evaluation method in a real sourcing situation at Cosworth Technology Ltd's Worcester foundry.

Overview :

The submission focuses on the use of the Supplier Performance Evaluation process on a group of new potential suppliers of aluminium material. Three new suppliers were chosen to take part along with two existing suppliers. The responses and analysis for each individual supplier is submitted in separate portfolio submissions (8.1 – 8.5).

The process was implemented and evaluated by a cross functional team. This process has now been included as part of Cosworth Technology Ltd's quality management system for use on all new sourcing decisions.

Submission 9 :

Case Study – Supplier Selection using the Supplier Performance Evaluation Datasheet at Cosworth Technology Ltd Engine Components

Purpose :

The purpose of this submission is to conduct a case study on the use of the Supplier Performance Evaluation Datasheet at Cosworth Technology Ltd's

Wellingborough facility using engine components suppliers. The study is intended to confirm the findings of the case study described in Submission 8.

Overview :

The supplier evaluation process was conducted on two suppliers of cylinder block 'push fit' liners. Of the two suppliers one had previously supplied Cosworth Technology Ltd whilst the other was a new supplier from Eastern Europe and had been proposed by Volkswagen / Audi (Cosworth Technology Ltd's parent company). The results of this case study confirmed the findings of the previous study detailed in Submission 8.

Submission 10 :

Business Capability Statement - Cosworth Technology Ltd's Wellingborough Manufacturing Facility

Purpose :

The purpose of this submission is to demonstrate the innovative approach of the Capability Statement and how it may be documented.

Overview :

The submission clearly illustrates how the capability statement can be used to get the attention of potential customers and therefore enables them to directly compare the reported performance against that of their existing suppliers. The Capability Statement describes the Cosworth Technology Ltd Wellingborough facility and illustrates its capabilities in complex CNC machining and engine

assembly. It describes the organisation's key performance metrics and continuous improvement initiatives.

Submission 11 :

Expert Opinion Survey Analysis

Purpose :

The purpose of this submission is to gather expert opinion from Purchasing and Quality professionals with experience of, or, responsibility for supplier selection. This opinion survey seeks to determine whether the Supplier Performance Evaluation process is perceived to be of value to industry as well as identifying potential ways in which it can be improved.

Overview :

The experts were chosen from automotive and non-automotive manufacturing organisations as well as relevant institutions and service providers. The opinion survey presented the background to the research and a detailed overview of the Supplier Performance Evaluation Datasheet. The experts were asked to rate the relevance of the content of the datasheet as well as its perceived effectiveness and ease of use.

The results of the survey clearly demonstrated that the experts found the evaluation process to be an effective process to determine the quality capability of a potential supplier. The majority of experts also stated that they believed that the process would be 'easy' to carry out and could add value to their own organisation's supplier management processes.

Submission 12 :

Summary & Conclusions

Purpose :

The purpose of this submission is to summarise the key issues identified from the research and to state the researcher's conclusions.

Overview :

The submission includes a review of the results of each of the key stages of the development of the research. This review then enables the research engineer to draw relevant conclusions regarding the use of the Supplier Performance Evaluation datasheet as a tool for supplier selection.

The conclusions contained within this submission confirm that :

a) 2nd and 3rd party assessment is unable to reliably determine the quality capability of a supplier organisation

b) the Supplier Performance Evaluation Datasheet was used successfully by Cosworth Technology Ltd in two separate sourcing decisions

c) the Supplier Performance Evaluation Datasheet was rated as a useful tool for supplier selection by a panel of supply chain experts

The submission also discusses opportunities for improvement of the process as well as areas for potential further research.

Ian Riggs

Warwick Manufacturing Group
University of Warwick

2.0 The Research

2.1 Initial Literature Review

2.1.1 Introduction

The initial literature review set out to understand how automotive quality management standards and third party certification have become the key focuses for supplier evaluation and supply chain development within the automotive industry. It was important to show how this fitted into the context of the development of the automotive global supply chain and other industry trends. The aim of the review is to establish if there is any evidence that the development and implementation of automotive industry quality standards such as QS 9000 and ISO / TS 16949 have achieved its claims of improved supply chain quality performance.

2.1.2 Automotive Industry Overview

The automotive industry has been established for a little over one hundred years and has become one of the world's largest industries. It is estimated to be worth £500 billion and employs over 65 million people world-wide (direct and indirect). In the Year 2002 it produced just over 45 million passenger cars and 16 million commercial vehicles (Auto Industry, 2003). A detailed overview of the automotive industry is included in Submission Two.

The industry is now spread across the globe. Traditional markets of Europe and America have reached saturation with excess capacity for the market (EIU, 2000 : Rhys, 1995). These pressures have forced some companies to

be acquired, merge or fail. The top four car manufacturers, GM, Ford, Daimler-Chrysler and Toyota account for over $450 billion sales and operate over 26 separate vehicle brands (Auto Industry, 2001).

During the past 10 years there has been a trend for VMs to outsource more and more of the assembly and design work to tier one suppliers. These suppliers are now responsible for providing complete systems and modules rather than individual components (EIU, 2001).

The effect on the supply chain has been many-fold :

- Tier one suppliers have become responsible for the entire downstream supply chain.
- Some tier one suppliers have had to take on more product complexity to support their customer base. System and module suppliers have become known as 'tier 0.5' suppliers because of these extra responsibilities (EIU, 2000).
- Many tier one suppliers have had to globalise to support their customers (Sturgeon & Florida, 1997).
- Suppliers have to commit to year on year cost reduction programmes (Whitbread, 1998).
- Supplier quality and delivery performance must demonstrate year on year improvements (ISO, 2002).

With bought in components and materials accounting for up to 70% of the cost of manufacture (Zeng, 2000) many organisations have moved their supply base to low cost production areas such as Eastern Europe, China or India at the expense of local suppliers to achieve the cost reductions expected of them by the VMs (Camuffo, 2000). A consequence of this move has been for many of the larger automotive suppliers to relocate their manufacturing facilities to these low cost production areas to retain a cost advantage and current business.

2.1.3 Supplier Selection in the Automotive Industry

However for the organisation that seeks to select a new low cost supplier there are threats as well as opportunities. Supplier selection can be a risky business. The cost of making a poor decision resulting in poor delivery performance and / or quality performance from a supplier is high (Perez & Sanchez, 2001).

Most organisations tend to use second party and/or third party quality assessments to verify the quality potential of a supplier prior to selection (Scrimshire, 2000). Although there has been a move towards third party certification using one of the automotive industry quality management standards to replace the need for second party audits, organisations still use second party audits to assess key suppliers.

Supplier selection methodologies used within the automotive industry are discussed in detail in Submission Three.

2.1.4 Quality Management Certification in the Automotive Industry

For many years the automotive industry had resisted the acceptance of generic quality management standards such as BS 5750 and ISO 9001 as it did not believe that these standards ensured the quality of the product being delivered to the customer (Hoyle, 1996). However it did recognise the benefits of third party assessment. These are (Riggs, 1997):

- The supplier pays for the cost of certification
- It removes the duplicated effort of multiple customer assessment
- Supplier audits are conducted by third party organisations, thus enabling the VMs to redeploy personnel to other areas

Therefore, the major Western VMs created automotive specific quality management standards, based upon ISO 9000, for use throughout the supply chain. The American VMs created QS 9000 whilst the German VMs established an equivalent standard, VDA6.1 (VDA6.1, 1998). These standards were very prescriptive compared to ISO 9001. In addition, the certification requirements were more stringent as were the auditor competence qualifications. This was designed to ensure that those suppliers who became certified to the standard would meet the quality performance requirements of the VMs. Hence the cost of certification to these new standards was comparatively high (AIAG, 2001).

In 1999 the automotive industry moved towards harmonisation of the various automotive standards by launching ISO / TS 16949 : 1999, the first global automotive standard accepted by the US and European VMs (ISO, 1999). In

2002 this standard was further updated and harmonised and is now supported by all major VMs including the Japan Automobile Manufacturers Association (JAMA) (ISO, 2002). Japanese VMs such as Toyota, Honda and Nissan have stopped short of requiring supplier certification to this standard. Nissan and Honda require their suppliers to 'comply with the requirements' of ISO / TS 16949 : 2002 although it is not clear how the supplier can demonstrate this without 3rd party certification. Toyota have tried and abandoned the use of ISO 9000 in its factories believing that it was of no benefit (Seddon, 2004).

However even with the prescriptive requirements, stringent auditor qualification programs and resulting high cost of certification, many in the automotive industry are questioning whether these new standards have achieved their stated aims (Reid, 1999 : Hutchins, 2001) . Johnson (2001) suggests that certification to QS 9000 is no guarantee that the company will provide consistent quality product or 100% on time delivery.

There is no clear evidence of quantifiable research to show if the new automotive standards have enabled certified companies to achieve improved quality performance compared to those certified to the generic ISO 9001. Seddon (2000) suggests that this is because there are too many vested interests in the current infrastructure to openly question its effectiveness i.e. certification bodies, consultants, standards organisations, etc.

Therefore, in the absence of any documented evidence the research set out to gather original data to show if there was any measurable improvement between suppliers certified to the generic ISO 9001 standard and those

certified to the automotive standards of QS 9000, VDA6.1 or ISO / TS 16949. Two case studies were conducted to gather the required data and these are described in Section 2.2.

2.2 Case Study : Determining the Correlation between Certification and Quality Performance

Two separate case studies were conducted to evaluate the difference in the results achieved between suppliers certified to one of the automotive quality management standards and the generic ISO 9000 standard. These case studies are included in full in Submission Four.

2.2.1 Case Study 1

In the first case study the quality performance, measured in parts rejected per million components supplied (PPM), of a group of 71, tier-one, automotive powertrain suppliers, certified to either ISO 9000 or an automotive quality management standard, were statistically analysed. The results showed that there was no significant difference between these two groups of suppliers. Figure 2 illustrates the actual results of this study.

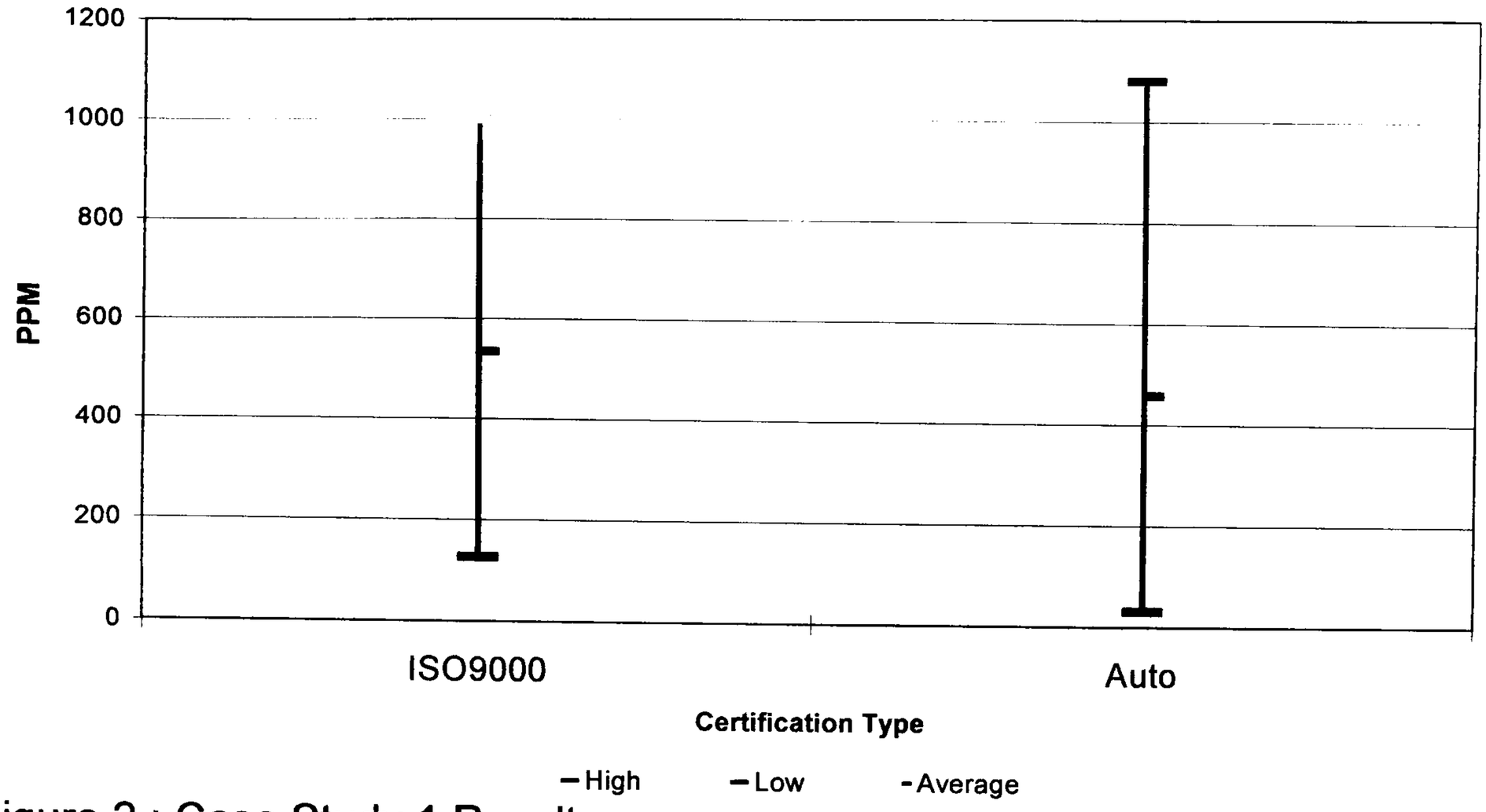


Figure 2 : Case Study 1 Results

2.2.2 Case Study 2

In the second study, involving 56, tier-two, automotive suppliers, again certified to either ISO 9000 or an automotive quality standard, the ISO 9000 suppliers significantly out performed those certified to the automotive standards. Figure 3 illustrates the results of this study.

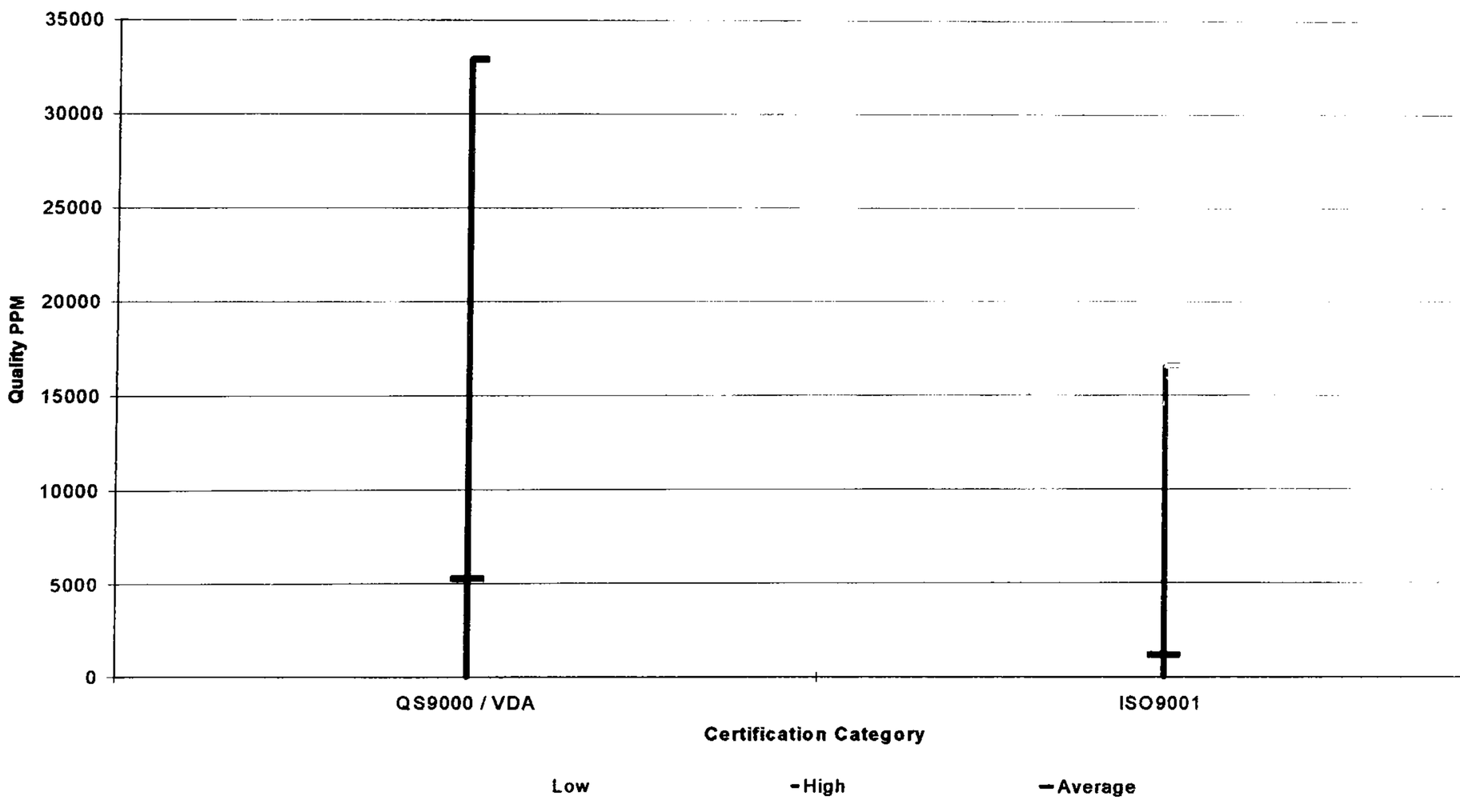


Figure 3 : Case Study 2 Results

The conclusion from these two case studies is that suppliers certified to an automotive quality standard do not have improved quality performance compared to those certified to the generic ISO 9000 model.

2.2.3 Case Study 3

During the course of conducting Case Study 1 the researcher also had the opportunity to analyse second party audit data and achieved quality performance. This analysis would establish if there was a better correlation between customer assessment and achieved quality performance than that identified with the third party approach.

In principle it would be natural to expect that second party audit results would correlate more closely with achieved quality performance. This is because the customer would have access to the supplier's quality data and first hand experience of the problems that the supplier had experienced in the supply of their product. This 'insider knowledge' should provide key clues for the auditor to focus on during the audit. However from an analysis of the data, shown in Figure 4, the correlation line is opposite to what we would expect showing that the suppliers with the lower (better) quality reject levels actually scored the lowest (worst) in the audit.

These three case studies demonstrated that the second and third party assessment approach is not a reliable indicator of a supplier's quality performance and therefore it can be concluded that an alternative approach to supplier evaluation is required, replacing the need for a third party certification standard to approve the quality capability of suppliers.

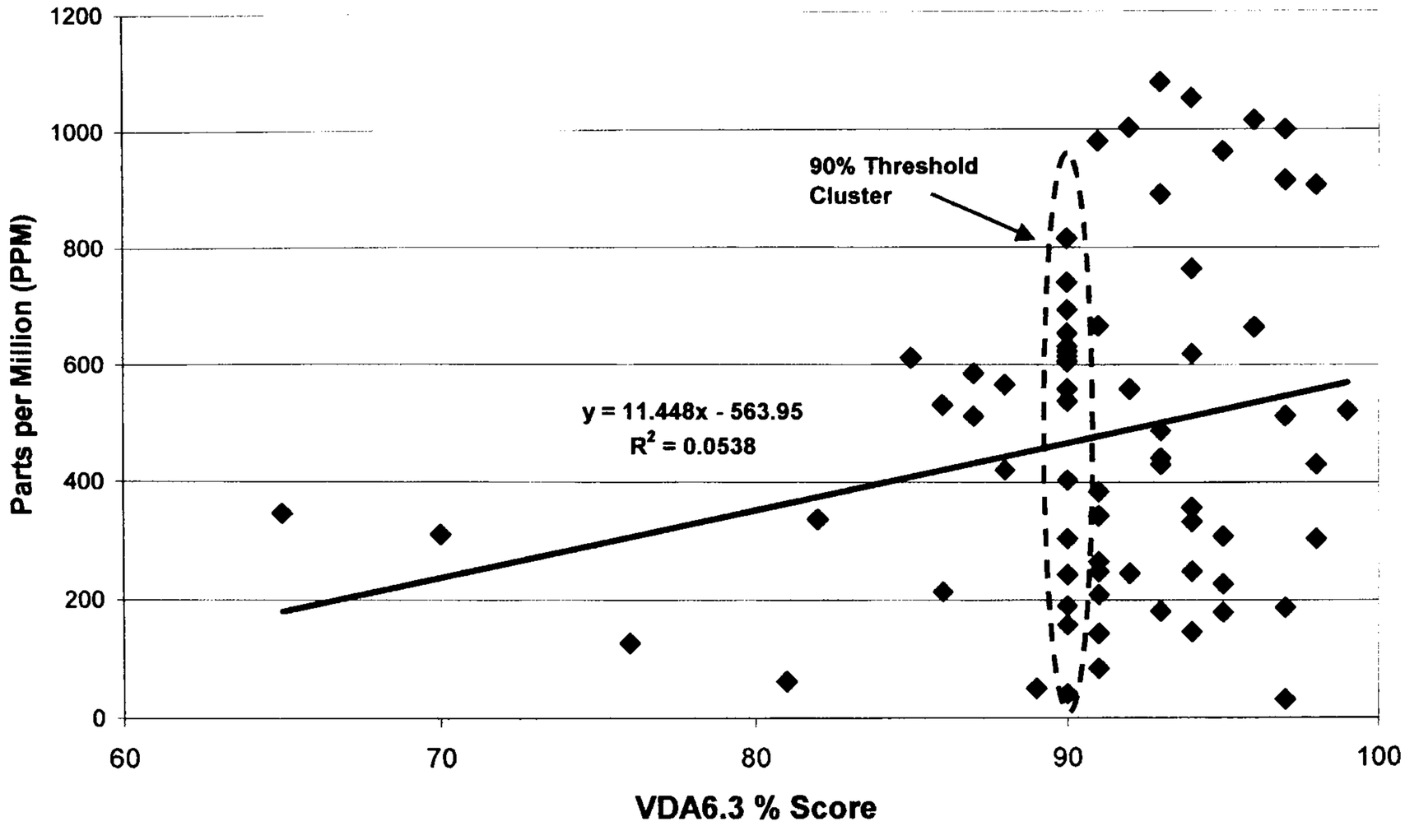


Figure 4 : Case Study 3 Results

These case studies evaluated two separate supply chains and a total of 126 suppliers. However as these suppliers invariably also supply other automotive customers the results can be assumed to be representative of the wider European automotive supply base.

At this stage of the research a second literature review was conducted, this time focussing on the use of alternative certification and assessment schemes, to determine if there were any innovations, which could enhance the effectiveness of the current quality management standards.

2.3 Further Literature Review

2.3.1 An Evaluation of Alternative Certification Schemes and Assessment Methods

The next stage of the literature review was the evaluation of other certification and assessment schemes to identify similarities and differences as well as to assess their effectiveness in meeting relevant performance standards. The review included an evaluation of industry quality management standards, environmental certification standards, and corporate social responsibility standards as well as the business excellence self-assessment methods of the Malcolm Baldridge Award and the European Business Excellence Award. A detailed description of this review is included in Submission 5.

2.3.2 Aerospace Quality Management Certification

The aerospace quality management system standard AS9100 based its structure on the automotive standard QS 9000. As with the automotive industry, the aim of developing such a standard was to standardise the quality requirements throughout the supply chain and prevent unnecessary duplication of audits and requirements on the supplier. (Scrimshire, 2001 : Gordon, 2000).

The standard was developed by major US aerospace companies, including GE Aircraft Engines, Lockhead Martin, McDonnell Douglas and Boeing who formed the American Aerospace Quality Group (AAQG) in 1995 in conjunction with the American Society for Quality (ASQ). Although similar in

structure to QS9000 and TS 16949 : 1999 the aerospace standard includes greater emphasis on industry issues such as:

- Role of regulatory authorities
- Reliability, maintainability and safety
- Design verification and validation
- Rework
- First article inspection
- Servicing and technical documentation
- The claimed benefits of certification to AS9100 are identical to those of QS 9000 and ISO / TS 16949.

It is anticipated that all major aerospace manufacturing companies will demand supply base compliance to AS9100. From a review of the standard's requirements and assessment method there is nothing to suggest that this standard would be any more effective than it's automotive equivalent.

2.3.3 Telecommunication Industry Quality Management Certification Schemes

The telecommunication industry has also developed a similar quality standard to QS 9000 and AS9100 for its suppliers, launched in 1999 called TL 9000. The standard was developed by member companies of the Quality Excellence for Suppliers of Telecommunications (QuEST) Forum, including Bell South, Alcatel, Nortel Networks and Lucent Technologies, to provide a

framework for quality improvement and cost effective products and services (Hutchinson, 2001 : QuEST Forum, 2001 (a)). A declared aim of the certification to the standard is to reduce the number of supplier failures (Walz, 2000).

A key innovation of the TL 9000 standard is the requirement for suppliers to provide key performance data to the QuEST Forum Data Administrator to enable coded benchmark data to be made available to member and non-member companies. The database is available through the World Wide Web. The cost of this service is $10,000 per annum for member companies and $20,000 for non-members (QuEST Forum, 2002). These high costs make it prohibitive for many Small and Medium sized organisations (SMEs).

Key measurements reported within the system include (Walz, 2000 : QuEST Forum, 2001 (b)):

- Number of problem reports (NPR)
- Problem report fix response time (FRT)
- Overdue problem report fix responsiveness (OFR)
- On-time delivery (OTD)

The purpose of this metrics system is to (QuEST Forum, 2001 (b)):

- Provide industry performance information suitable for benchmarking
- Improve telecommunications processes and products
- Identify improvement opportunities and

- Standardise customer report cards or assessments.

The certification process is identical to that of ISO 9000, with the exception that the organisation must also subscribe to the TL 9000 Registration Repository System (RRS) or 'Metrics Database' and provide the required data, in the required format. Before an organisation can be considered for registration it must provide at least 3 months data into the RRS. The certification body shall ensure that the organisation has robust processes for the collection and reporting of this data and that any discrepancies are dealt with within the certification body's prescribed time limit (QuEST, 2001 (b)).

2.3.4 Environmental Certification Standards

The first set of 'non-quality management' standards evaluated were those concerned with environmental management, BS 7750, ISO 14001 and the Eco-management and Audit Scheme (EMAS). BS 7750 and ISO 14001, although based on the principles of ISO 9000 : 1987, have a much simpler structure than the twenty clauses of the quality standard. The environmental management standards are more focussed on the organisation's continuous improvement activities than simply compliance to procedures (ISO, 1996). Even so the implementation of ISO 14001 only became popular when major VMs and other purchasing organisations made them a mandatory requirement amongst their supply base (Ford, 2001 : ENDS, 1999). The success of these standards had a major influence on the structure of the revised ISO 9000 launched in the Year 2000 (ISO 9000:2000).

EMAS is different to ISO 14001 and ISO 9000 in one key respect. It requires subscribing organisations to publish a verified report on its environmental

performance using key environmental indicators. The report has to be made available to the organisation's key stakeholders such as customers, suppliers, employees, local residents and regulatory authorities.

As with ISO 9000 some are suspicious of the benefits of ISO 14001 and EMAS as there are examples of certified organisations that fail to meet environmental legislation and have therefore been prosecuted. However research has shown that organisations certified to EMAS have demonstrated improved performance over those with only ISO 14001 (ENDS, 2000 : ENDS 2001). Many environmentalists insist that for certification to be effective it should include performance criteria and defined minimum standards (ENDS, 2002).

2.3.5 Corporate Social Responsibility Standards

The final certification scheme to be evaluated was that of the relatively new area of Corporate Social Responsibility (CSR). There are three main standards published to date, these are SA 8000, AA 1000 and the Global Reporting Initiative (GRI).

SA 8000 and AA 1000 are set out in a similar structure to ISO 9000. The assessment process is also similar to that of ISO 9000 although there are some key differences. These include the establishment of minimum performance standards that the organisation must meet, a review of key performance indicators and consultation with key stakeholders such as employees, customers, society, suppliers, etc (AccountAbility, 2002 : SAI, 1999 : GRI, 2000 : Leipziger, 2001 : White, 2002). Stakeholder consultation is

used to verify the claims of the organisation and includes 'perception' as well as quantifiable data.

GRI is similar in approach to EMAS and requires organisations to publish key performance indicators in three main categories, these are Economic, Environmental and Social. With a lack of mandate from key purchasing organisations, standards such as EMAS and CSR currently have very low number of certifications.

2.3.6 Business Excellence Models

Business Excellence Models such as the Malcolm Baldridge National Quality Award (US) and the European Business Excellence Award are not certification standards. They are designed to assess the activities (enablers) and achieved performance (results) of the entire organisation and are based on the principles of Total Quality Management (TQM). This type of assessment goes beyond that of a first party or internal audit, which is more concerned with compliance to procedures and processes.

The models enable an organisation to conduct self-assessment against a set of defined criteria and scoring mechanisms. The purpose of self-assessment is to identify areas of organisational strength as well as opportunities for improvement. For many organisations these self-assessments form the basis of their continuous improvement activities.

The model places a high degree of emphasis on the key performance metrics used within the business including quality, social and financial. Key data is typically trended over a three-year period in order to understand the

development of the organisation. The European Foundation for Quality Management (EFQM) claims that the European Business Excellence Model is used by (EFQM, 2001):

- More than 20,000 organisations across Europe
- 60% of Europe's largest 25 companies
- 9 of the 13 European companies in the Financial Time's 50 Worlds Most Respected Companies in 2001
- at least 10,000 Small to Medium Enterprises (SME's)

The models are also used as the basis for regional and national quality awards. The aim of these awards is to recognise and promote best practice.

Organisations who enter for the award are required to prepare a documented submission that illustrates how they meet the defined criteria. The submission is assessed by a team of experienced assessors using defined scoring guidelines. Organisations that score above a certain threshold may also receive a site visit from the assessment team to gather additional data or clarify aspects of the submission document. Only national award winners are required to publish their performance data.

Summary

There are certification schemes that have evolved further than those of ISO 9000 and ISO / TS 16949. The key innovations have been :

- Review of key performance indicators and trends (EFQM)

- Industry reporting of key performance indicators (TL 9000)
- Public reporting of key performance indicators (EMAS, GRI)
- Establishment of minimum performance standards (SA 8000)
- Stakeholder engagement (SA 8000, AA 1000)

Figure 5 illustrates how certification standards have evolved and the relative position of ISO / TS 16949 : 2002.

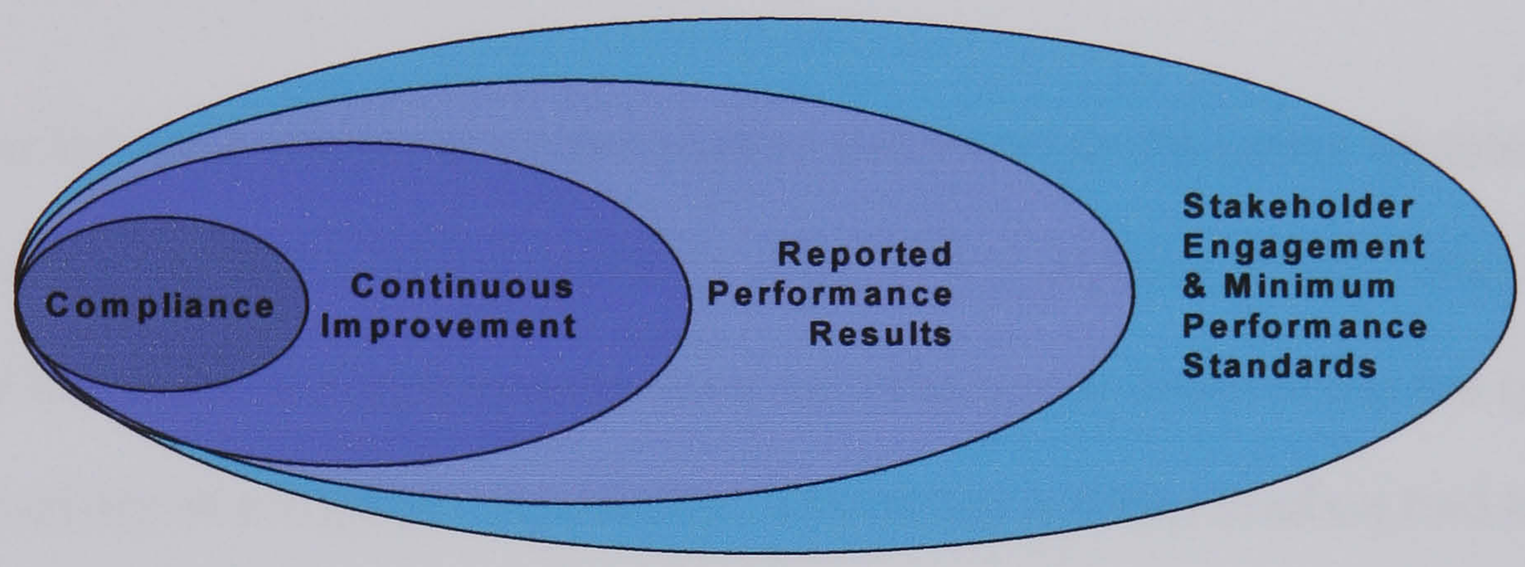


Figure 5 : Evolution of Certification and Assessment Schemes

The model shows the evolution from the prescriptive approach of the early and current quality management standards. These standards assume that there is a single management approach to suit all organisations regardless of size and complexity. The prescriptive approach is typical of traditional Quality Management (Sousa & Voss, 2002).

The standards that focus on the 'results' of the organisation provide the basis of a contingent approach where the analysis of the key performance indicators (including benchmarking) enables an organisation to identify specific areas for improvement and control. The contingency approach

suggests that the management practices it should adopt is based upon its own organisational context and will differ depending upon the size, complexity and structure of the organisation (Benson, Saraph & Schroeder, 1991). In particular the EFQM model does not prescribe any management controls or processes for the organisation although it does seek to establish a 'cause and effect' relationship between what the organisation does (the enablers) and what it achieves (the results) (Hakes, 1999).

2.4 Scope of the Study

The literature review and case studies described in the earlier chapters enabled the scope of the research to be clearly defined. It was concluded that the traditional audit processes were not effective at determining the quality capability of a supplier organisation and hence another method had to be established.

The literature review suggested that there were other certification schemes that had developed from the basis of ISO 9001 and had introduced several enhancements to take account of some of the problems identified with second and third party certification. These are :

- Establishing minimum performance standards
- Producing transparency for key metrics through public reporting
- Engaging key stakeholders to verify the organisation's performance / claims

Therefore, these would be considered in the development of a supplier evaluation process. The supplier evaluation process is designed to :

- Evaluate the quality performance of new / unknown suppliers to the organisation using minimum performance standards

- Enable the comparison of performance data to that already available for the organisation's existing approved suppliers

- To be verified without the need for second or third party assessment

- To take account of the specific requirements of different commodity suppliers i.e. It shall utilise a contingency approach to enable the process to be adapted to the specific needs of the supplier group under evaluation.

The research shall concentrate on quality performance evaluation but recognises that the process may benefit from further expansion to include other criteria such as operational, financial and environmental performance indicators. The supplier performance evaluation process shall be primarily designed for use in the automotive industry although it shall also consider its general applicability to non-automotive sectors.

The supplier performance evaluation process accepts that within the automotive supply chain it will have to include the requirement for suppliers to be certified to an automotive certification standard (this is mandated by the VMs). Therefore the evaluation process shall build on the certification standard requirements when developing the evaluation criteria.

2.5 Research Methods & Measurements

The research paradigm is primarily phenomenological in nature as opposed to positivistic. This type of paradigm is more suited to research where the results will be qualitative and the quality and richness of the data, taken from small sample groups, provides high validity (Hussey & Hussey, 1997). The data sources in this type of study tend to be subjective and care must be taken to ensure the obtained results are interpreted accurately and are representative of the wider population. In order to overcome potential problems with sample bias associated with small sample sizes and the subjectivity of the data the research incorporates the use of data and methodological triangulation (Easterby-Smith, Thorpe & Lowe, 1991). Denzin (1970) argues that the use of triangulation leads to greater validity and reliability.

During the course of the research several research methods have been utilised to gather data and evaluate the success of the research proposal. This chapter discusses the chosen research methodologies as well as the methods of measurement of success.

2.5.1 Methodologies used for Data Collection

A key methodology used to collect data within this research has been through a comprehensive literature review. The literature review enabled the researcher to develop an understanding of the main subject areas, including its development, current and future issues (Hart, 2000). There were various sources of information for the literature review including :

1 University, British and County libraries

2 Key professional journals including Quality Progress, Quality World, BSI Standards

3 Internet journal resources via the ATHENS portal

4 Relevant organisations including the Society of Motor Manufacturers & Traders (SMMT), Chartered Institute of Purchasing & Supply (CIPS), Automotive Industry Action Group (AIAG), Wales Development Agency

5 Other research centres including Massachusetts Institute of Technology (MIT), Cardiff University, Wales Quality Centre

6 Company data including Ford, General Motors, Volkswagen, Audi, GKN, Lear Corporation and BAE Systems.

7 International Standards including ISO, VDA, etc.

Not all of the literature was in the public domain. The research includes private correspondence between the researcher and individual companies as well as reference to their company policies and procedures. In order to collect data on the relationship between second and third party audit results and achieved quality results three separate case studies were conducted (Included in full in Submission 4).

Case studies are usually associated with the study of single phenomena in a defined environment. In this context the case study set out to describe what was already happening within the organisation and hence these three studies can be referred to as 'descriptive case studies' (Scapens, 1990). The reason

these case studies were important to the research was that there was a lack of documentary evidence in the available literature to confirm the hypothesis that organisations certified to one of the automotive quality management standards achieved superior quality performance to organisations certified to the generic standard ISO 9000. Within the case studies statistical analysis including hypothesis testing using the 'student's t' test were performed to verify the results.

The third methodology used to collect data to define the criteria to be used within the Cosworth Technology Supplier Performance Evaluation Process was that of semi-structured interviews. This methodology was used to interview senior managers from Cosworth Technology, including quality, purchasing and manufacturing functions. When conducting these surveys a second researcher was used to conduct some of the interviews where it was felt that the position of the main researcher, as Quality Director of the company, might influence the respondent's answers. This is known as researcher triangulation (Hussey & Hussey, 1997).

Although the prime purpose of the supplier evaluation process is for use within Cosworth Technology two other automotive tier one organisations were also interviewed to gain additional information regarding their experience of the use of key performance metrics in the supplier evaluation process. In addition a comprehensive literature review was undertaken to evaluate industry requirements and expectations for supplier evaluation criteria. By selecting inputs from these three different sources the researcher was able to compare and contrast the data provided. This is known as data triangulation

(Hussey & Hussey, 1997). The choice of this methodology as well as other potential methodologies that were evaluated but not used is included in Submission 6.

Easterby-Smith, Thorpe & Lowe (1991) propose the use of semi-structured interviews in the following circumstances :

- Where it is necessary to understand the construct that the interviewee uses as a basis for his or her opinions and beliefs about a particular matter or situation

- The subject matter is highly confidential or commercially sensitive

- Where the interviewee may be reluctant to be truthful about this issue other than confidentially in a one-to-one situation

The interviews were recorded using an audio device and transcribed later. This enabled the researcher to concentrate on the interviewee and ensure that the responses were relevant to the questions. It also allowed the researcher to make any notes regarding non-verbal communication such as body language, which added further insight into the interviewee's responses. Note taking was also very useful after the formal interview as the researcher found that on two occasions the interviewee 'relaxed' when the audio device was switched off and continued to make useful comments regarding the research topic. The criteria selected for use as part of the supplier performance evaluation datasheet shall be evaluated further to test its wider applicability as part of the expert opinion survey described in section 2.8.

2.5.2 Methodologies used for Research Evaluation & Measurement

In order to evaluate the success of the proposed Supplier Performance Evaluation process three key activities were conducted during its development. These were :

a) Initial pilot study by Cosworth Technology Ltd

b) Two supplier selection case studies conducted by Cosworth Technology, Worcester and Cosworth Technology, Wellingborough.

c) An opinion survey of professional experts in the field of supplier selection

The case study approach used for the pilot study is described by Scapens (1990) as 'an experimental case study' where the research evaluates the implementation of a new process or procedure in an organisation. The analysis of the results of the pilot study can be described as 'within case' as it does not seek to compare its results with other case studies. The success of the pilot study will be for the Cosworth Technology management team to adopt the process for use within its key purchasing processes. Only after the new process has been approved will it be possible to move onto the next stage of the evaluation.

The next set of case studies used to evaluate the use of the proposed supplier selection process is referred to by Scapens (1990) as 'an illustrative case study' where the study aims to illustrate the use of a new process once it has been established. The research chose two different supplier selection situations to illustrate the use of the supplier evaluation process. The first case study was completed by the Cosworth Technology, Worcester Foundry

management team on a group of potential material suppliers. The second case study was conducted by the Cosworth Technology Wellingborough management team on two potential component suppliers.

The success of the Supplier Evaluation process would be judged by the ability of the process to provide validated key quality performance data, which could be compared to existing approved suppliers. The process had to operate within the timescales required by the business and the data provided had to be in a format, which could be used easily by the Cosworth Technology management team. The final measure of the success of the proposed process would be its formal adoption into the business (quality) management system.

In these case studies a form of 'participative or co-operative enquiry' was adopted to enable the management team to become involved in the design and implementation of the process and in its analysis (Hussey & Hussey, 1997). This form of phenomenological methodology is attributed to produce better quality data because of the involvement of the co-researchers (Traylen, 1994).

The ideal measurement of success would be to demonstrate that suppliers selected using this process actually met the quality capability suggested from the analysis of their performance. However because of the long introduction times of new automotive products it was not possible to wait for these results within the registration period of the research. Therefore the evaluation of the success of the process had to be limited to the opinion of the Cosworth Technology management teams and through a survey of expert opinion.

The final, and most important, evaluation of the proposed process would be through a form of opinion survey using industry experts in the field of supplier selection. A detailed description of this evaluation is included in Submission 11.

The experts were asked to assess the proposed supplier performance evaluation process after reviewing a CD-Rom presentation, which was designed to provide an overview of the process. A questionnaire was used to capture their responses and to solicit further comments related to how the process may be improved.

The questionnaire aimed to evaluate the following areas :

a) The relevance of the content of the four sections of the proposed process

b) The ease of use of the process, for the organisation, the supplier and the supplier's existing customers

c) The usefulness of the process as a tool for industry

The important measurement to be analysed from these responses was :

1 The effectiveness of the customer data verification process

2 What percentage felt that the process was useful to industry?

3 What percentage felt that the process would add value to their own organisation?

4 The achieved rating for the ease of use

The questionnaire responses also allowed for the confirmation of the content of the Supplier Performance Evaluation Datasheet as well as the capture of enhancements that the experts felt were useful.

2.6 Creating the Supplier Performance Evaluation Process

The Supplier Performance Evaluation process was developed in collaboration with Cosworth Technology Limited (CT), a major automotive supplier of powertrain components and engine assemblies. Its purpose is to improve the reliability of the assessment of potential suppliers to the organisation.

CT is certified to ISO / TS 16949 : 2002 and as a consequence is required to ensure that its supply base is also certified to this standard (or ISO 9001 : 2000 as a minimum). It is necessary therefore to specify the requirement for third party certification even though CT recognises that the benefits of such certification has been shown to be limited.

2.6.1 The Supplier Performance Evaluation Process

The evaluation process was designed to supplement the existing supplier profile questionnaire process already in use at CT. The questionnaire included descriptive details of the potential supplier such as location, products, types of process, existing customer base and quality certification(s).

This information enables the purchasing function to set up an account for the potential supplier. The supplier is only approved following a detailed financial review, using the Dunn & Bradstreet information database, and successful completion of the relevant quality assessment (for key component suppliers this is in the form of a second party audit using VDA6.3).

The aim of the supplier evaluation process is to replace the need for second or third party assessment with a review of actual performance data, verified through stakeholder engagement, in this case through a customer referral process. The structure of the evaluation datasheet is shown in Figure 6. It shows that the original supplier questionnaire has been enhanced through the inclusion of the requirement for the supplier to report on key performance indicators as well as to have this data verified through contact with existing customers (stakeholder engagement).

Supplier Questionnaire + Metrics + Stakeholder Engagement

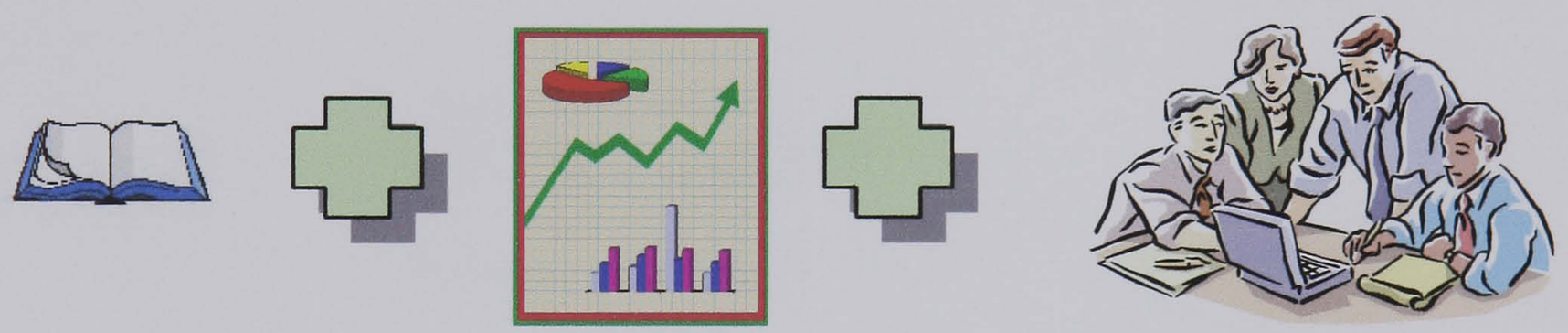


Figure 6 : The Supplier Performance Evaluation Structure

The data had to enable CT to compare the results of the potential supplier to those of its existing suppliers of similar components. The process flow for the proposed Supplier Performance Evaluation process is illustrated in Figure 7.

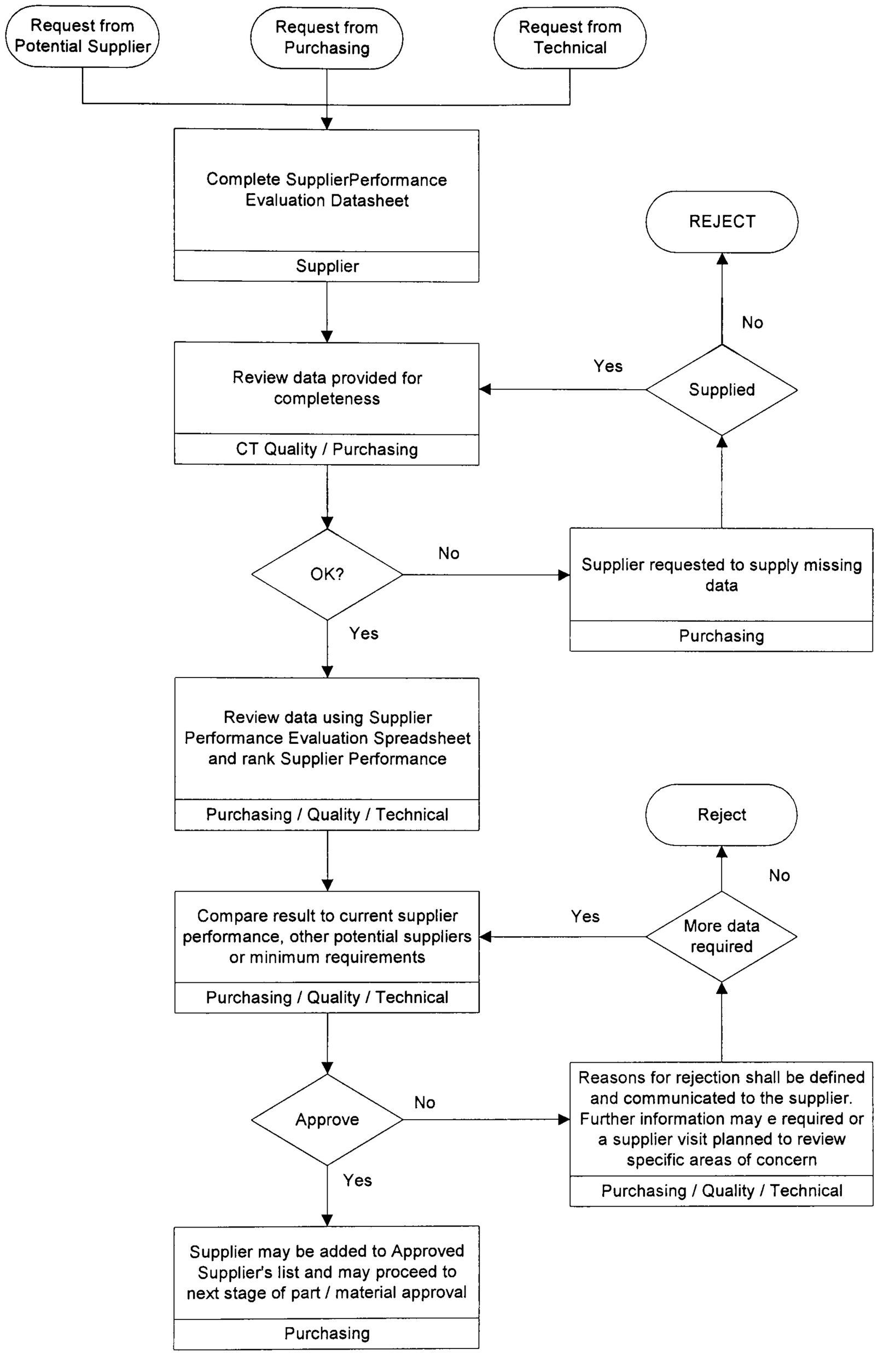


Figure 7 : The Supplier Performance Evaluation Process

2.6.2 The Supplier Performance Evaluation Datasheet

The development of the Supplier Performance Evaluation Datasheet is described in detail in Submission 7, while the development of the performance metrics used as part of the process is described in Submission 6. The performance metrics were chosen from a review of current practice within the automotive industry as well as from a detailed review of the literature. The final version of the datasheet is included in Appendix A. It has four main sections :

Section 1 : General supplier information

This section was closely aligned to the original supplier profile questionnaire. It requires information on the supplier's locations, ownership and management structure, product ranges, turnover and industries served. It also provides details such as the supplier's Dun & Bradstreet number (or equivalent) and a list of customer accreditations or quality certifications.

Section 2 : Process capability

This section requires the supplier to provide process capability data, which describes the scope of the business and the quality capability achieved on current products. It describes the types of process equipment used, its process capability and utilisation. This description also includes the measurement equipment and facilities used on site as part of its process. It also identifies the use of external sub contract processes or measurement facilities required to supply its products.

The key metrics covered in this part of the datasheet are :

1. Process capability (Cpk, Ppk), and

2. Gauge capability (GR&R)

Section 3 : Performance Metrics

This section requires the supplier to provide trend data on the following key metrics (as applicable) :

1. External Quality Performance (PPM)

2. Internal Quality Performance (PPM)

3. Number of Customer Quality Discrepancies in last 12 months

4. % Repeat Customer Discrepancies in past 12 months (Concern effectiveness)

5. External Rework Performance (PPM)

6. Internal Rework Performance (PPM)

7. Supplier Quality Performance (PPM)

8. External Quality Audit Results

9. Warranty (Field Returns) Performance (PPM)

Where available, data is required for a three-year period and should include target data and benchmark data. An example of the required format is included within the datasheet and is shown in Figure 8.

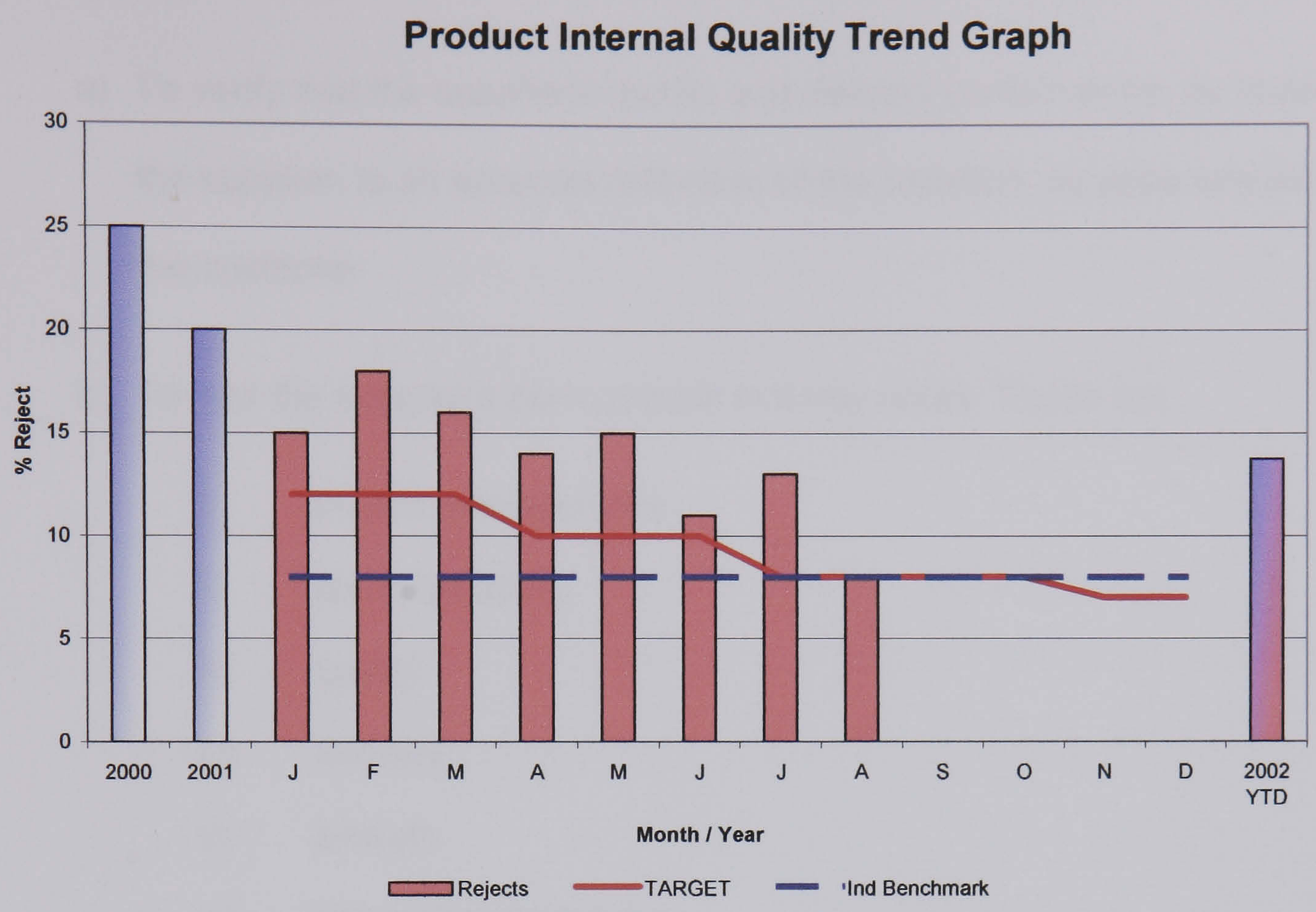


Figure 8 : An Example of the Format for Reporting Key Metrics as Required by Section 3 of the Supplier Evaluation Datasheet

By using a common format for all suppliers CT will be able to easily compare the data with that of other new suppliers as well as existing suppliers. It is recognised however that some of the metrics may need to be omitted, adapted or include other specific measures for certain supplier / commodity groups. This decision would be made by the cross functional team responsible for the supplier sourcing decision.

Section 4 : Customer referral

This section requires the supplier to provide the names of at least 2 key customers. They shall be contacted by CT to validate the customer specific data provided and provide feedback on aspects of the supplier's performance. The customer contacts should typically include the purchasing and supplier quality contacts.

The customer referral questionnaire has three key objectives :

a) To verify that the supplier's quality and delivery performance, as stated by the supplier, is an accurate reflection of the situation, as experienced by the customer

b) To rate the supplier's performance in 6 key areas. These are :
   i) project management
   ii) technical ability
   iii) quality
   iv) delivery
   v) attitude
   vi) general performance

c) To compare this performance with other, similar, suppliers and indicate if it is better, same or worse i.e. benchmarking of supplier performance

The customer also has an opportunity to make comments on each of these areas as well as to provide some general comments that may be relevant. The aim of this questionnaire is to validate the information provided by the supplier and hence remove the need for second or third party assessment.

2.6.3 Using the Supplier Performance Evaluation Datasheet for Supplier Selection

The Supplier Performance Evaluation Datasheet (Appendix A) will be used for two main purposes :

a) to select suppliers for a new piece of work for which there are no existing suppliers

b) to identify potential new suppliers who may be more competitive than existing suppliers

In the first instance the completed datasheets will be compared to each other in order to identify the best option. In the second instance performance data from a new (potential) supplier will be compared to that of existing suppliers to determine whether or not they have the capability to provide a performance advantage.

The following evaluation process was developed to compare the performance of different suppliers using the Performance Evaluation Datasheet as well as to those on the approved supplier's list. The evaluation process selects the relevant performance data elements from the datasheet and includes them in a simple spreadsheet, as shown in Table 1 (Column 1 in Table 1). A cross-functional team then evaluates the list and identifies a minimum acceptable performance level for each element (Column 2 in Table 1). If a supplier does not meet these minimum requirements then the evaluation will not continue and they will not be included in the subsequent comparison.

The next step is then to agree on a priority rating for each element, for that particular commodity (column 4 in Table 1). This rating may change depending upon the nature of the supplied part and will need to be reviewed for each selection decision. Guidelines were developed in order to apply some rationale to the scoring of the priority rating. The guidelines used were :

0	Will have no influence on the customer's performance incl. quality, delivery & cost.
4	May impact the customer's internal performance, final customer not affected.
6	Will impact the customer's internal performance regarded as important criteria by the customer. Final customer may be affected.
8	Will impact the customer's external performance or is a final customer requirement.
10	Critical to the success of the customer's own performance or a final customer requirement.

The minimum requirements and priority rating will be the same for all suppliers undergoing comparison for a particular supplied part or material. The actual performance data from the completed Supplier Datasheet is then included (column 3 in Table 1). The next stage is to review the results and agree on a performance rating for the supplier (column 5 in Table 1). This is a team review and consensus scoring is required. Again guidelines were developed to assist the scoring. These were :

0	No data provided / data provided shows that customer quality and delivery ***will*** be affected. Supplier does not comply with specified criteria.
4	Limited data provided / data shows that customer quality and/or delivery ***may*** be affected.
6	All data provided. Some elements do not meet minimum requirements.
8	Fully compliant with requirements / performance data is satisfactory. Supplier complies with specified requirements. There is evidence of positive trends.
10	Fully compliant and data suggests that the supplier is Best in Class. Optimum level achieved. There is clear evidence of positive trend over three years.

From this information a score for each applicable element can be calculated by multiplying the 'Priority' rating and the 'Performance' rating together

(columns 4 and 5) and this is shown in column 6 of Table 1. Finally a Supplier Overall Evaluation score is calculated by :

((Actual number of points scored from all relevant elements) / (total number of points possible)) x 100%

Table 1 : Supplier Evaluation Process Example

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
Element	Minimum Requirements	Actual Result	Priority Rating	Performance Rating	Element Score
Quality PPM	1000 (max)	500	10	8	80
Delivery on Schedule	98% (min)	95%	10	4	40

An example of the Supplier Datasheet Comparison form is included in Appendix B.

2.7 Implementing the Supplier Performance Evaluation Process

Once the Supplier Performance Evaluation process had been defined it was decided to implement it within Cosworth Technology Ltd in two stages. First a pilot study was conducted at the Wellingborough manufacturing facility to test its ease of use and obtain feedback on how it may be improved. Secondly it was used in two real sourcing decisions to determine its effectiveness as a tool for supplier selection (Case Study A and Case Study B).

2.7.1 Pilot Study

A detailed description of the pilot study is included in Submission 7.

CT's Wellingborough management team was required to complete the Supplier Performance Evaluation Datasheet as if it was a request from a potential customer. The team was asked to evaluate the ease of data collection and the time and effort required to complete the datasheet.

The feedback was captured using a facilitated meeting with the management team. The key findings were :

Section 2 : Process capability

This section required the team to describe the current process equipment employed, its utilisation and capability (including laboratory equipment). It found that although the data existed it was not in a readily available format and the team had to spend several hours organising the data for submission.

The team did conclude however that once this had been done the data would be readily available for future use.

Section 3 : Performance Metrics

The team agreed that the information requested was readily available and in a format which enabled it to provide the required data easily without much effort. Many of these metrics are used weekly as part of the operational management review.

The team raised a concern over the presentation of 'cost of quality' data to a potential customer. The team stated that in a real situation they would not be willing to present any cost information, which may be used to benchmark the company against other suppliers. For the purposes of the evaluation case studies this requirement was removed from the datasheet.

Section 4 : Customer referral

The team's main concern was that from its experience of conducting customer satisfaction interviews it recognised that the customer's views could vary significantly depending upon recent performance history. However this was not a point, which it felt should prevent its use and it would be willing to provide contact details if requested.

In conclusion the team felt that the process was manageable and the amount of effort required was not prohibitive. It did make a point that it would only spend the time on completing such a process if it was certain that the customer enquiry was genuine and that the company had a real chance of winning new business.

2.7.2 Case Study A

CT Worcester Foundry – Aluminium Ingot Supplier Selection

In order to demonstrate the use of this process in a real situation it was used to evaluate three proposed suppliers to Cosworth Technology Ltd's (CT), Worcester Foundry. Volkswagen (VW), CT's parent company, nominated the potential suppliers for evaluation. The case study is documented in Submission 8. CT has two existing suppliers of aluminium ingots, in the study these are referred to as Supplier 1 and Supplier 2. The three proposed suppliers are referred to as Supplier 3, Supplier 4 and Supplier 5. Supplier 5 is based in Germany whilst the other suppliers are based in the UK.

Each supplier was sent a copy of the Supplier Profile Evaluation Datasheet and the performance measurement guidelines. They were requested to complete the datasheet within 1 month of receipt and to return it to the Group Quality Function for evaluation.

CT's current supplier rating system does not include all the metrics used by the Supplier Performance Evaluation Datasheet and therefore in order to compare the performance data of the proposed suppliers with that of the existing suppliers Supplier 1 and Supplier 2 were also sent evaluation datasheets to complete. CT recognises that the supplier rating system will need to be developed in order to enable useful comparison with data provided by the datasheet.

The researcher established a cross functional team to evaluate the supplier submissions. The team consisted of :

- Technical Director, Worcester Foundry
- Quality Manager, Worcester Foundry
- Senior Buyer, Worcester Foundry
- Group Purchasing Manager
- Group Quality Director (researcher)

The team set the minimum requirements and priority rating for each evaluation element during the first of the team meetings. These ratings were applied to each supplier. The next stage was for the team to review the supplier data and to allocate marks for performance based upon the data. These marks were agreed using consensus scoring and the guidelines developed by the team. Table 2 summarises the team's scoring of the supplier datasheet evaluation submissions. Figure 9 illustrates the results for the overall scores.

Table 2 : Case Study A : Supplier Datasheet Evaluation Results Summary

Supplier	**Overall Score**	**Section 1 General Info**	**Section 2 Process Capability Score**	**Section 3 Performance Metric Score**	**Section 4 Customer Satisfaction Score**
Supplier 1	35 %	69%	17 %	31 %	60 %
Supplier 2	44 %	78%	21 %	51 %	60 %
Supplier 3	74 %	83 %	58 %	85 %	100 %
Supplier 4	57 %	80 %	50 %	50 %	60 %
Supplier 5	12 %	48 %	6 %	3 %	0 %

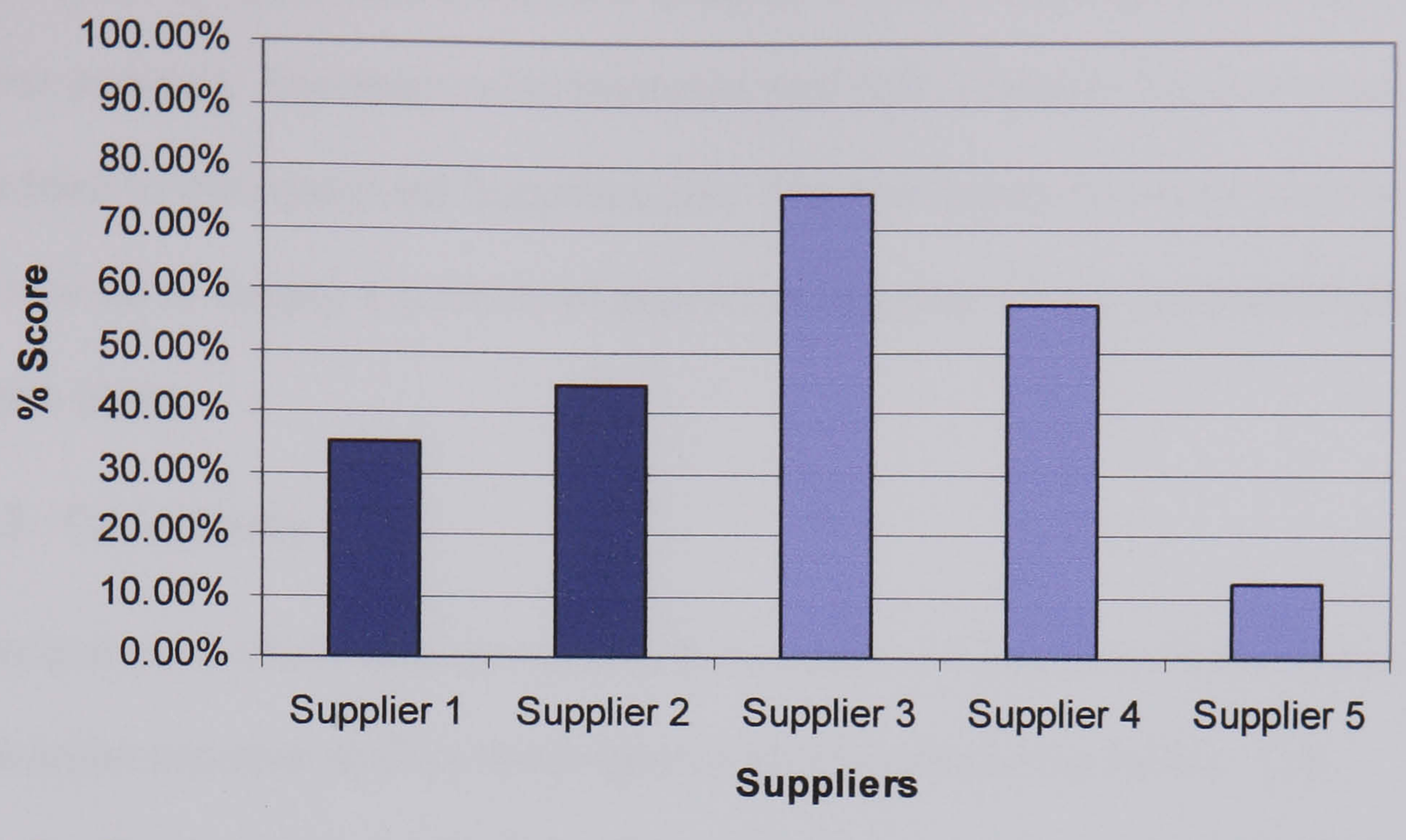


Figure 9 : Case Study A : Supplier Datasheet Evaluation - Overall Scores

In can be seen from Figure 9 that two of the proposed suppliers, Supplier 3 and Supplier 4, significantly outscore the two existing suppliers, Supplier 1 and 2. Supplier 5's score was very low at just 12%. This was due to the lack of information supplied within their submission and the misunderstanding of the customer satisfaction questionnaire. They were given an opportunity to supply the missing data but did not respond.

Further analysis showed that Supplier 3 out performed all of the other suppliers evaluated in each of the key sections. In particular the capability data and performance metrics scored highly. Their overall score of 74% was 17 points higher than their nearest competitor, Supplier 4, and 30 points higher than Supplier 2, the higher scoring existing supplier. Supplier 4 also scored favourably compared to the two existing suppliers. The key differentiator was the capability data and the metal cleanliness data which both of the existing suppliers were unable to provide satisfactorily.

Because of the poor response from Supplier 5 they were discounted from any further analysis. The team recommended that both Supplier 3 and 4 should be added to the Approved Suppliers List. The next stage for these suppliers will now be to supply a quantity of aluminium ingot to CT for production trials to take place.

2.7.3 Case Study B

A second case study was conducted to evaluate the Supplier Performance Evaluation process at CT's Wellingborough manufacturing facility. The Supplier Performance Evaluation Datasheet was used to assess potential suppliers of cast iron cylinder bore liners. The suppliers were Supplier 6, an existing supplier to CT based in the UK and Supplier 7, a new supplier based in Poland.

The process was conducted in the same way as for case study 1. A detailed discussion and analysis is included in Submission 9. In this case the cross-functional team comprised :

- Senior Buyer
- Technical Manager
- Group Purchasing Manager
- Group Quality Director

The results of the evaluation of the two suppliers are shown in Table 3.

Table 3 : Case Study B : Evaluation Results

Supplier	Overall Score	Section 1 General Info	Section 2 Process Capability Score	Section 3 Performance Metric Score	Section 4 Customer Satisfaction Score
Supplier 6	66	80	69	73	40
Supplier 7	74	64	73	80	80

In this example Supplier 7 consistently outscored Supplier 6 in every area. However the team understood that the Supplier 6 score was affected by the complexity of the current components supplied to CT. This issue resulted in lower scores for both process capability and customer satisfaction (scored by CT personnel).

The team proposed that due to the amount of supplier development already provided to Supplier 6 and their positive response that they would be awarded the contract in spite of the results. Supplier 7 was added to the approved suppliers list and will be considered for future business.

2.7.4 Case Study Results

Once the case studies were completed the cross functional teams were asked to comment on the process and make recommendations for improvement. Both teams saw the process as a useful tool in the supplier selection process. In particular its ability to provide relevant data upon which to make decisions. The formal evaluation process removed the problems of bias by individual departments or team members.

The teams identified the following learning points from the application of the Supplier Evaluation Datasheet :

a) For each type or family of components / commodity there may be specific questions that the team wish to add to the datasheet and therefore the process should allow for team input before the questionnaire is sent out. i.e. although the process is based upon a standard pro-forma document there must be a contingency approach adopted by the team to enable them to target the criteria to the specific attributes of the suppliers being compared.

b) The cover letter should clearly state that the customer satisfaction questionnaire must be completed by the Customer's Supplier Quality function and not solely the Purchasing function.

c) Suppliers should be given the same time frame in which to respond to the questionnaire.

d) The standard scoring process shall be referenced as part of the cover letter so that suppliers can understand the basis of the evaluation and hence the importance of supplying the required information.

Further Actions

The Supplier Datasheet Evaluation process used in this case study has been documented and included within the CT Quality Management System. This process will enable suppliers to be added to the approved suppliers list without the need for second party audits conducted by CT or VW. The process owner is the Group Purchasing Function which will use a cross functional team to conduct these assessments. Typically this team will include

Purchasing, Technical and Quality and may be supported by other functions as appropriate.

In order to further evaluate the success of this evaluation method CT shall monitor the success of the 'new suppliers' to meet their quality potential as described within their datasheet submissions. Due to the long new project introduction timescales it is anticipated that decisions made during 2003 will not be validated until late 2004 or early 2005 (typically new product introduction projects at CT take 18 – 24 months to introduce into production).

2.8 Expert Opinion Survey Results

In order to further assess the effectiveness of the Supplier Performance Evaluation process it was decided to conduct a survey of industry experts to provide a critique of the proposed process and to assess its relevance to industry. Submission 11 describes the Expert Opinion Survey development, implementation and analysis of results.

The survey was conducted to provide additional evaluation of the proposed supplier performance evaluation process to that provided by the experimental and illustrative case studies described in section 2.7. This additional evaluation enabled data triangulation (comparing data from different sources) as well as methodological triangulation (comparing data from a quantitative methodology, i.e. survey results, to that of data from a qualitative methodology i.e. case studies). The analysis and conclusions of the effectiveness of the SPED process is derived from all of these sets of data.

2.8.1 Expert Selection

Initially 30 experts were identified to take part in the study. This sample size may be regarded as small for statistical evaluation where the size of sample is required to be representative of the whole population (in this case the whole population would be all automotive organisations) (Lapin, 1990). However even in quantitative analysis there are no strict guidelines as to what sample size is required to provide a reliable result. Lapin (1990) puts forward that sample size is determined by balancing the reliability and accuracy required by the study as well as the cost of conducting it.

In order to ensure that the selected sample of experts were representative of the wider population from which they were drawn it was important to select individuals who had extensive experience of and responsibility for supplier selection. As a result the experts tended to be the head of their respective purchasing or supplier quality functions from organisations that represented the whole spectrum of the automotive supply chain.

Each expert was contacted by the researcher to obtain his or her consent to take part in the survey. The majority of experts were identified from members of the Society of Motor Manufacturers and Traders (SMMT) Quality Panel, which comprises of all VMs based in the UK and major tier one organisations. Fourteen out of the 16 automotive organisations were identified through this forum.

In addition to these automotive contacts, experts were also identified from the non-automotive manufacturing sector (6 organisations) as well as relevant service sector organisations (8 contacts). In this initial group there were 12 purchasing professionals, 15 quality professionals and 3 'other' category professionals.

Survey Questionnaire

The purpose of the questionnaire was to establish the views of the experts regarding the Supplier Performance Evaluation Datasheet, in particular :

- Confirmation of the choice of performance metrics

- The effectiveness of the customer referral process

- The ease of use of the Supplier Performance Evaluation Datasheet

- The usefulness of the Supplier Performance Evaluation Process

The questionnaire also sought to record any recommendations or observations from the experts, which would enhance the process. The Survey Questionnaire was divided into four key sections, each with its own purpose (refer to Appendix C).

The questionnaire was designed to capture opinions using a rating scale known as a likert scale (Hussey & Hussey, 1997). This enabled the responses to be 'visualised' using graphical analysis, in this case histograms. This analysis enabled the researcher to quickly identify patterns in the data such as the distribution of responses for each question. It was then possible to clearly identify opinions that do not fit with the norm and which would require additional evaluation to understand the cause.

Section 1 : Survey Participant Details

This section was used to record the name, position and company of the survey participant along with their contact details. It also requested the number of years that they have spent in industry and in their current position. This data was used to gauge the amount of experience of those taking part in the survey.

Section 2 : Current Organisation Supplier Assessment Practices

This section comprised three key questions relating to the supplier assessment practices of the respondent's organisation. Question 1 asked if

the organisation required their supplier base to be third party certificated to a quality management standard and to specify the standard used.

Question 2 asked if the organisation conducted its own 2nd party assessment of its supply base. If the answer was 'yes' or 'sometimes' then they were asked to specify the standard used. If the answer was 'sometimes' then they were also asked to define the conditions, which define when second party assessments are required.

Question 3 asked if the organisation currently reviewed performance data prior to supplier selection. If the answer was 'yes' then they were required to describe the metrics reviewed. The purpose of this section was to establish the current supplier assessment processes used by the participating organisations as this may have some relevance when reviewing their responses to the proposed supplier performance evaluation process.

Section Three : Confirmation of the Criteria used in the Supplier Performance Datasheet

This section asked the evaluators to rate each specified performance metrics included within the Supplier Performance Evaluation Datasheet using a five point Likert scale. Each criterion can be ranked as one of the following ;

- Vital
- Important
- Useful
- Of some use

- No use

In addition the evaluators were asked to recommend other criteria that they believed would add value to the process. They also had the opportunity to make comments regarding the specific section under review including opportunities for improvement.

Section 4 : Overall Evaluation of the Supplier Performance Evaluation Process

This final section asked the evaluators to make an overall judgement on the Supplier Performance Evaluation process in terms of its ease of use and its usefulness, again using a five point Likert scale. A final question asked them to state if they believed that the process would benefit their current organisation. Again they were encouraged to add any comments on the overall process, which they felt might be relevant to the research.

Conducting the Survey

Survey questionnaires were sent to each of the experts along with a CD-Rom, which contained a 13-minute presentation that described the development and use of the Supplier Performance Evaluation Datasheet. This presentation was designed to enable the experts to quickly review the background to the research and to illustrate the use of the Supplier Performance Evaluation Datasheet in order for them to effectively complete the questionnaire.

Survey Results

Of the 30 questionnaires despatched 15 were returned for evaluation. Simon (1985) states that it is the quality of the participants that is important, not the

quantity. In this case the respondents had 288 years of experience between them, an average of 19.2 years each, and included 5 company directors, 7 senior managers and 3 at other levels. They also represented a cross section from the automotive industry, including Vehicle Manufacturers, multinational tier one components suppliers as well as SMEs. In addition 2 non-automotive multinational manufacturers were included as well as 3 service sector organisations.

Confirmation of Key Performance Indicators

The survey results showed that over 97% of the responses rated the key performance indicators as either 'useful', 'important' or 'vital'. The responses also identified a list of 45 additional metrics which individually they suggested may also be included as part of the Supplier Performance Evaluation Datasheet. Of these 45 additional metrics no themes emerged, rather they were a list of random measures. The research had identified that some organisations may wish to include metrics that were specific to their own organisation. The datasheet is designed to be flexible in order to allow organisations to adapt the criteria to suit their needs.

Customer Referral Process

All of the responses rated the criteria included within this part of the process as 'useful' or higher. Sixty-five percent rated the process as 'vital' to confirm the supplier's performance data.

Overall 93% of the respondents rated the process as either 'effective' or 'very effective'. Only one response stated that they believed that the customer referral process was of 'limited effectiveness'.

The respondents were also asked to evaluate the 'ease of use' of this process for the potential customer, the potential supplier and the current customer. Although the results for each were all in excess of 50% the score for the ease of use by the current customer was the lowest at 57%. Three responses stated that they felt that it might be difficult to get the current customer to take the time to complete the survey, as there appeared to be little benefit to them. Cosworth Technology Ltd did not experience any such difficulties in the two case studies but it is an issue where further work may be required to simplify the process.

Overall Results

The analysis of the survey results showed that 80% of the respondents thought that the process was easy to carry out whilst 13% thought that it was 'not very easy', as shown in Figure 10.

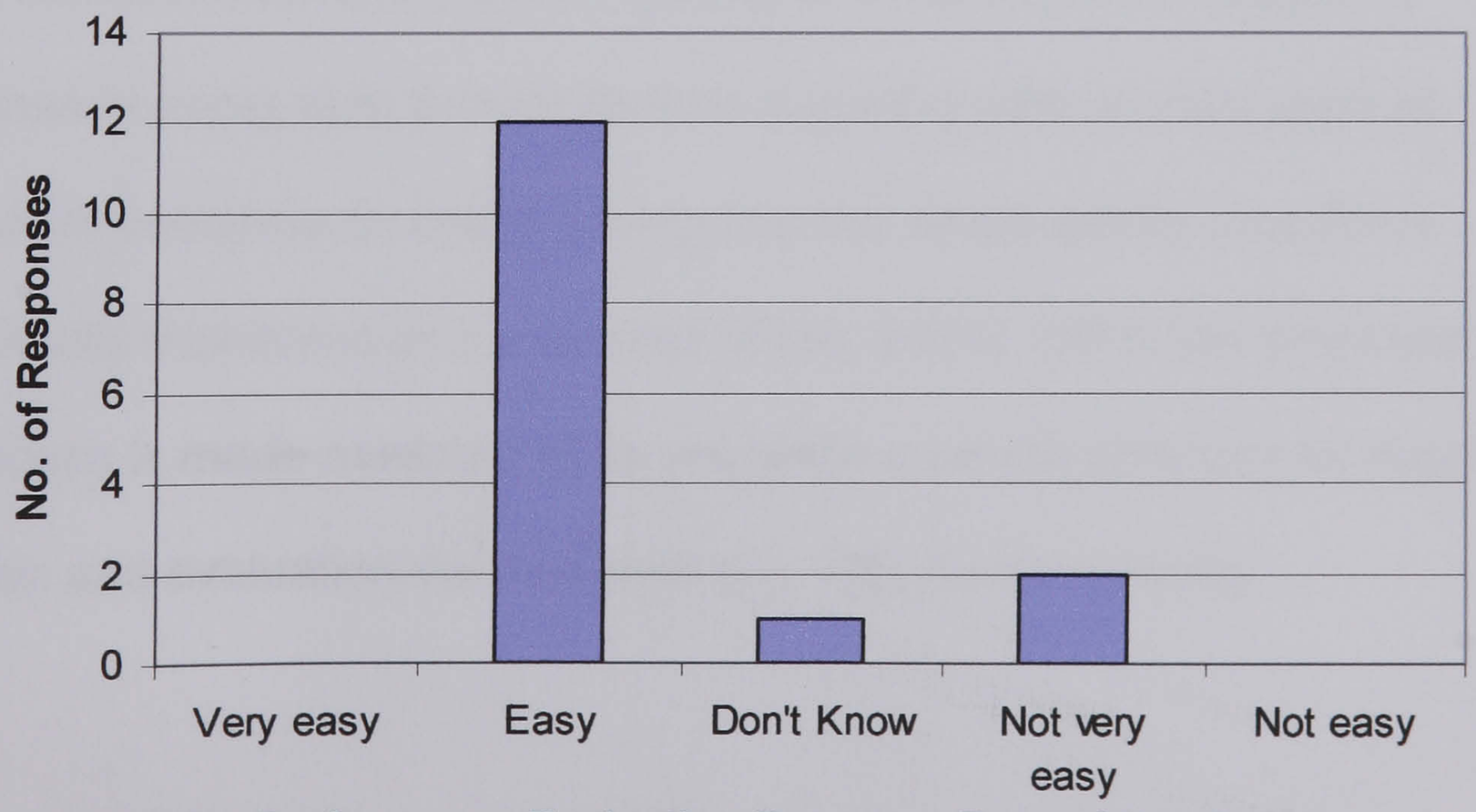


Figure 10 : Supplier Performance Evaluation Process : Ease of Use Rating

Ninety-three percent of the respondents rated the process as either 'useful' (33%) or 'very useful' (60%), as shown in Figure 11.

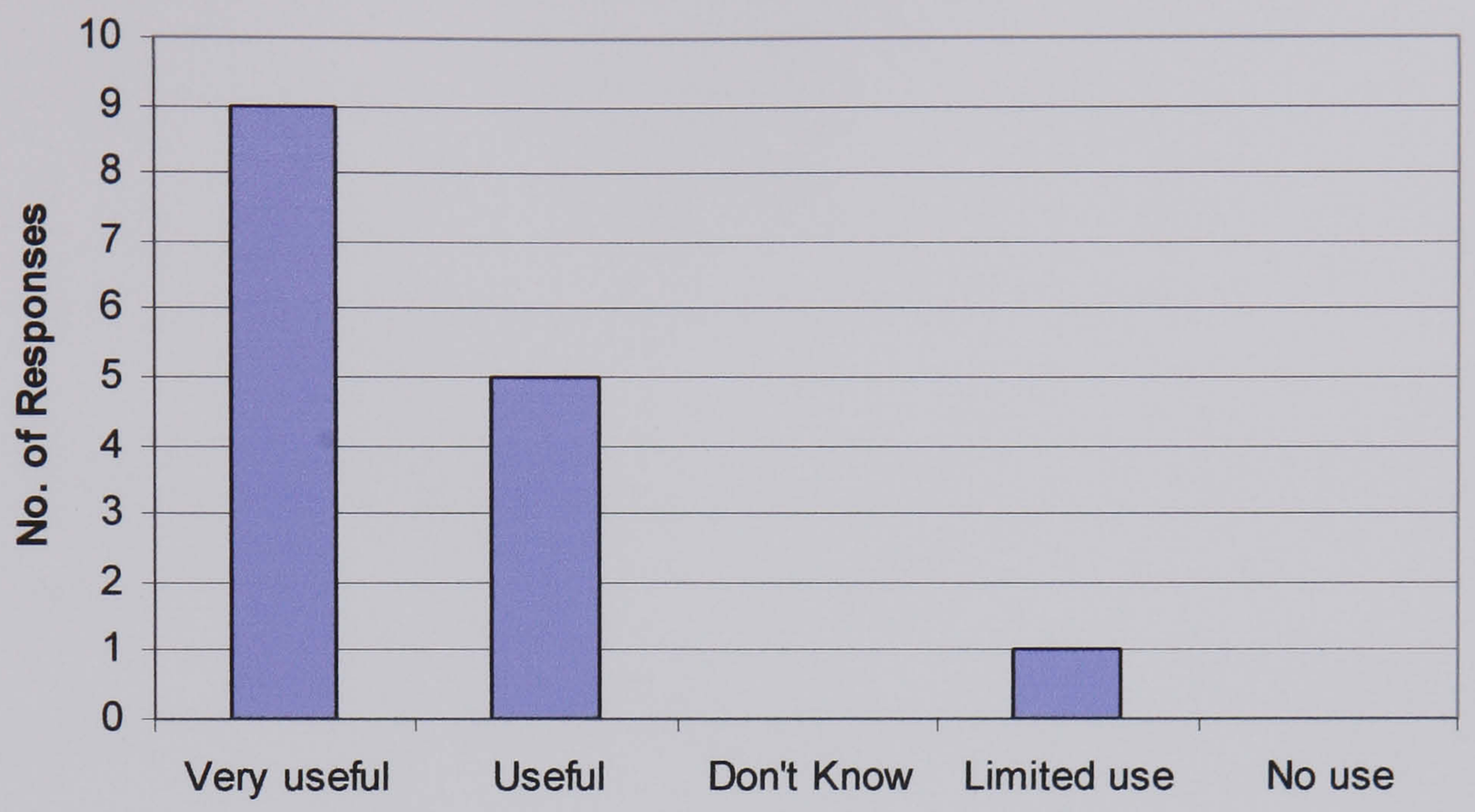


Figure 11 : Supplier Performance Evaluation Process : Usefulness Rating

All respondents stated that they believed that the process could add value to their current supplier management processes. The Chartered Institute of Purchase & Supply (CIPS) was unable to take part in the survey as its policy prevents it. However it did review the Supplier Performance Evaluation Datasheet and stated that '.. the Supplier Performance Evaluation Datasheet is very comprehensive in terms of getting to understand the supplier's processes in being able to manufacture a good quality product such as automotive components and ensuring that the whole quality process is continuously monitored and improved' (Ford, 2004). CIPS has proposed that the process is made available to its members as a valuable tool for supplier selection and evaluation via their web site, http://www.cips.org.

Cosworth Technology Ltd has implemented this process into its quality management system and Masushi (TAP) has requested assistance in implementing the process into its quality management system.

3.0 Demonstration of Innovation

One of the key features of the Engineering Doctorate (Eng.D) programme is that it must be possible to 'demonstrate innovation in the application of knowledge to the engineering business environment'. For the purposes of the Eng.D innovation is defined as 'where something new is being done or some familiar problem is being tackled in a new way' (WMG, 2000 a).

There are three aspects of the Supplier Performance Evaluation process that are able to demonstrate such innovation. These are :

a) The establishment of a performance-based quality evaluation model.

Quality certification schemes currently do not include performance criteria or standards within their assessment process. Although they do require organisations to measure key performance indicators there are no minimum requirements defined, only the need to 'demonstrate ongoing improvement'. Some organisations do specify quality targets as part of their supplier monitoring analysis (supplier rating) but this is only applied to existing suppliers and not the evaluation of potential suppliers (Ford, 2001).

Only SA 8000 specifies performance criteria as part of its certification process. In this case it is applied to welfare issues such as the minimum age of employment, number of hours worked per week, minimum wage, etc.

The Supplier Performance Evaluation process requires the organisation to set minimum performance targets for each key indicator. Failure to meet any one of these targets will exclude the supplier from further consideration.

b) Data verification using stakeholder engagement

One of the key objectives for the supplier performance evaluation process was that it would not require second or third party involvement to validate the data provided by the potential supplier. The cost of conducting such verification, especially in suppliers based in different countries, was seen as prohibitive to many tier one and two organisations.

However data verification was perceived as an important issue and not one that could be ignored. It was therefore proposed to utilise stakeholder engagement (in this case the current customer) to verify that the data included within the supplier evaluation datasheet was representative of their experience with that supplier. The research identified that other stakeholders may need to be consulted if the process included other categories of data such as environmental or safety.

This is a key feature of Corporate Social Responsibility standards such as SA 8000 and AA 1000 and to a limited extent EMAS. There are no examples of where this is used to verify quality performance data as part of a supplier selection process.

c) The creation of a business capability statement for use as a marketing tool

The Supplier Performance Evaluation process is initiated by the prospective customer with its potential suppliers. One further development is to use the same structure and rationale to produce a 'capability statement', which can be used by an organisation to attract new customers. The capability statement is similar to that of the EMAS and GRI reports with the exception that it is a much broader document, covering the whole business and providing key performance data to its prospective customers.

The data is validated in the same way as the Supplier Performance Evaluation Datasheet where the organisation's current customers would provide a referral based upon the data included within the statement. An example of how the capability statement could be documented is included in Submission 10.

4.0 Summary & Conclusions

The purpose of this chapter is to summarise the key findings of the research and to show how they address the research question and objectives.

The research question was defined as :

How can the current supplier selection practices used within the automotive industry be improved to ensure effective decision-making?

The research objectives are :

i) To critically evaluate the current practices of supplier selection and approval within the automotive industry and identify opportunities for improvement. In particular to evaluate the role of 2nd and 3rd party certification methods in supplier selection.

ii) To evaluate other supplier certification and assessment schemes to identify best practice

iii) To establish a robust, reliable, and cost effective process for supplier selection that can be used within the automotive industry to support the industries global purchasing strategies.

iv) To evaluate the proposed supplier selection process by using it in real sourcing decisions and from a survey of industry experts.

4.1 Automotive Supplier Evaluation Processes used in Supplier Selection

Initially the research set out to compare the effectiveness of automotive third party certification schemes, such as QS 9000 and ISO / TS 16949, against that of the generic ISO 9001 standard. The prime purpose of third party certification is to enable organisations to move away from conducting their own supplier assessments (second party assessment) thereby removing duplicated effort and cost throughout the supply chain.

The automotive industry had taken the structure of ISO 9001 and developed it to provide additional assurance that certified suppliers would meet their quality expectations. They achieved this by :

- Including additional prescriptive requirements which focussed on the quality of the process and product
- Changing the acceptance criteria of the audit results to make it more difficult to achieve certification
- Implementing a stringent third party auditor qualification process

These enhancements were designed to overcome their perceived problem with ISO 9001, which was that organisations certified to ISO 9001 could still provide poor quality products. The literature review did not provide evidence that the automotive standards had achieved this aim. Therefore it was necessary to conduct two case studies to determine if automotive certified organisations actually achieved better quality performance than those certified to the generic ISO 9001 standard.

4.2 Case Study Results

In the first case study the results showed that there was no significant difference between the two groups of suppliers while the second case study actually showed that those suppliers certified to ISO 9001 out performed the automotive certified suppliers. This is certainly a contradiction to what the proponents of the automotive certified standards had led the industry to expect. It shows that the achieved quality performance of an organisation is not correlated to the type of quality management standard that it is certified to. Therefore there must be other factors that influence the quality performance of the organisation.

Submission 4 identifies some of the major factors that have a direct bearing on the product quality performance of an organisation. These are :

- Complexity of the component
- Components, which require further processing by the customer
- The customer – supplier relationship
- Customer specified 'non-capable' processes
- High volume versus low volume supply
- Accurate individual reject counting versus 'batch' rejections

It is not just third party audits that were unable to demonstrate a correlation to the quality performance of the organisation. In a third case study involving 71 suppliers that had been assessed to the Volkswagen VDA6.3 process audit

their audit scores were correlated to the achieved quality performance. In this case the correlation was the opposite of what we would expect with the lowest scoring audit results achieving the better quality performance.

4.3 Case Study Conclusions

One conclusion from these case studies is that the 'auditing process', to whatever standard, does not correlate to the achieved quality performance of the organisation. With this in mind it is difficult to understand how an organisation can rely on third party certification or second party assessment as a mechanism to discriminate between the quality capabilities of a group of suppliers.

There are clues to suggest that many organisations recognise that they cannot rely on third party certification alone. For example all of the tier one suppliers that took part in the expert opinion survey conducted second party supplier audits as well as specifying third party certification to a relevant industry quality standard. Many of these organisations actually used the same standard for their second party assessment as for their specified third party certification. The implications of these findings are highly significant.

Firstly the supply chain has to absorb the cost of third party certification and second party supplier assessment. In 1998 the AIAG estimated that the average cost of maintaining QS 9000 was in the region of $40k (£23k) per annum (AIAG, 2001). Therefore the elimination of second and third party assessment would save the automotive industry millions of pounds each year. Secondly the results from the third and second party assessment process provides unreliable data upon which to make supplier selection decisions.

The conclusion is therefore that an alternative process is required to reliably measure the quality capability of a potential supplier and to use this measurement as part of a supplier selection process.

4.4 An Evaluation of other Certification Schemes

The first stage in developing an alternative supplier evaluation process was to benchmark other certification schemes to identify if there were any enhancements or innovations which may overcome some of the problems identified with the second and third party assessment process (described in detail in Submission 5). The conclusion from this evaluation was that standards such as the Eco-Management & Audit Scheme (EMAS), the Business Excellence Model and SA 8000 had introduced more emphasis on the results of the business rather than just an assessment of its processes. Studies had shown that EMAS certified organisations had better performance records than those certified to just ISO 14001. SA 8000 had also introduced minimum performance criteria for key metrics as well as stakeholder engagement to verify the claims of the organisation.

It appeared logical that if a supplier were to publish its quality performance data, or at least make it available to a prospective customer, then the customer would be able to compare this data against other suppliers and make a decision based on fact. Alternatively the customer can set minimum targets that need to be achieved so that the supplier data can be compared to them.

The use of stakeholder engagement can be used to verify the data and thus avoiding the need for expensive second or third party involvement, hence lowering the cost of the assessment process.

4.5 Supplier Performance Evaluation Datasheet

The Supplier Performance Evaluation Datasheet process set out to establish the quality capability of a potential supplier through the reporting of key performance metrics, verified through stakeholder (customer) engagement. The metrics selected for the research were primarily focussed on the quality performance of the organisation although it was recognised that it could easily be expanded to include other categories.

4.6 Evaluation of the Supplier Performance Evaluation Process

Cosworth Technology Ltd tested the datasheet in three stages, firstly as a pilot study and then in two separate supplier selection case studies. The results showed that the datasheet provided clear performance data that could be easily compared to other suppliers using the datasheet or from the supplier rating of existing suppliers.

The studies concluded that care must be taken to ensure that the reported performance metrics relate to similar products so that the comparison with other suppliers would be meaningful. The process has been adopted by Cosworth Technology Ltd and is now part of its quality management system.

4.7 Expert Opinion Survey

In order to widen the assessment of the Supplier Performance Evaluation process an opinion survey of industry experts was conducted. The results

showed that they rated the process as 'useful' and 'easy to carry out'. All respondents stated that the process would add value to their current organisations.

Although there was only a small representation from non-automotive organisations there is no reason why the process could not be applicable to any industry, including services. However one point was raised which will need further consideration. The use of the customer referral process to confirm the supplier metrics raises two potential issues. These were :

a) Would the customer respond to the request and complete the necessary data?

b) Where the referral process asks the customer to rate the supplier against certain criteria there may be legal implications for the customer if the supplier was shown to have lost business as a result.

Although Cosworth Technology Ltd did not experience these problems within its own case studies these points may become an issue if the process is implemented by a large number of tier one organisations. For the purposes of the proposed Supplier Performance Evaluation process it is the validation of the supplier data that is most critical. To overcome the identified issues there may be alternative methods of verifying the suppliers achieved quality data. These include :

- The supplier may be able to provide a copy of a customer quality report which demonstrates their quality performance e.g. Ford's Supplier Improvement Metrics monthly report.

- The supplier may produce it's own customer specific quality performance summary report and have their customer representative to review and endorse it. The supplier can then provide copies to interested potential customers.

- The supplier may produce a capability statement (as described in Submission 10) and have this endorsed by its major customers.

- The supplier may provide the potential customer with an overview of its customer satisfaction data (required by ISO / TS 16949 and QS 9000)

In each case the responsibility to provide the validated data to the potential customer lies with the supplier. For the existing customer the advantage is that they would only have to endorse the supplier data once every 12 months.

4.8 Summary

The research has shown that third party certification and second party supplier assessment do not reliably provide accurate data on the quality capability of a supplier. Even with all the additional requirements, stringent auditor qualifications and assessment processes of the industry standards there appears to be no improvement in results.

As supplier evaluation is the prime purpose of both these assessment methods the research suggests that they have failed to meet their objectives. It asks the question 'why should industry continue to use second and third party assessment?'

It is clear that many organisations would be opposed to abandoning second and third party assessment. Many service organisations have based their livelihood on the perpetuation of the third party certification standards e.g. certification bodies, consultants, training organisations, etc. Many manufacturing organisations have entrenched views on supplier assessment and deep-rooted organisational issues to address.

Some may argue that there are other benefits from the use of certification standards including a shared terminology and common (standardised) processes. These may be valid points in support of the use of management standards as 'guidelines' but do not justify the requirement for third party certification and its associated costs.

The Supplier Performance Evaluation datasheet process has demonstrated that by adopting a performance based approach to supplier evaluation, reliable, robust data can be used to make sound decisions. Although developed within the context of the automotive supply chain it has been shown that it can be applied to any industry and it is flexible enough to enable an organisation to customise it for its own needs.

5.0 Proposals for Further Extension to this Work

The research has demonstrated the use of the Supplier Performance Evaluation Datasheet between the customer and potential supplier. This process may be developed further and be applied in alternative ways :

- The development of a 'performance based' quality management standard that can be used to provide a generic framework for supplier assessment.

- The Capability Statement described in Submission 10 has not been applied in a practical situation. It would be useful to conduct further research into the application of this approach to test its effectiveness in winning new business.

In addition there are areas of the research, which would benefit from further development :

- The customer referral process described in the research may need to be developed further to provide a solution which is not a perceived as a burden to the customers required to complete them.

- The process could be further developed to include additional key metrics e.g. environmental, social and financial

- Additional case studies could be conducted to test the process in other industries

6.0 References

AccountAbility (2002), *AA1000 Assurance Standard : Guiding Principles* [online]. London : The Institute of Social and Ethical Accountability. Available from : http://www.accountability.org.uk [Accessed on August 23rd 2002].

AIAG (1995), *QS9000 – Quality System Requirements*. Second Edition. Detroit : Automotive Industry Action Group

AIAG (1998), *QS9000 – Quality System Requirements*. Third Edition. Detroit : Automotive Industry Action Group

AIAG (2001), *1998 Quality Survey Results (North American Suppliers)* [online]. Detroit : Automotive Industry Action Group. Available from : http://www.aiag.org/quality/qsurvey.html [Accessed on January 14th 2001].

Auto Industry (2001), *Vehicle Manufacturers - Statistics* [online], Available from : http.//www.autoindustry.co.uk/statistics/company/vehicle.html (Accessed May 18 2001)

Auto Industry (2003), *Vehicle Manufacturers - Statistics* [online], Available from : http.//www.autoindustry.co.uk/statistics/company/vehicle.html (Accessed October 30th 2003)

Benson, G., Saraph, J. & Schroeder, R. (1991), "The Effects of organisational Context on Quality Management : An Empirical Investigation", Management Science, 37 (9), 1107 – 1124

Bird, M. [Malcolm.bird@gkndriveline.com], May 24th 2004, RE : Jana & TS 16949. E-mail to Ian Riggs [iriggs@Cosworth-technology.co.uk]

BSI (2002), *AS 9100 Registration* [online]. Chiswick : BSI. Available from : http://emea.bsi-global.com/Aerospace/Registration/index.xalter [Accessed on March 12th 2002].

Camuffo, A. (2000), "Rolling out a "World Car" : Globalisation, Outsourcing and Modularity in the Auto Industry", IMVP Working Paper, Massachusetts : Massachusetts Institute of Technology

Denzin, N. K. (1970), *The Research Act : A Theoretical Introduction to Sociological Methods*, Chicago : Aldine

Easterby-Smith, M., Thorpe, R., and Lowe, A. (1991), *Management Research : An Introduction*, London : SAGE Publications

EFQM (2001), *Assessor Training Modules*, Brussels : European Foundation for Quality Management

EIU (2001), *Paradigm Shift in the Automotive Industry : The Changing Relationship between Suppliers and Manufacturers*, London : Economist Intelligence Unit

EIU (2000), *World Automotive Components : Market Prospects to 2005*, London : Economist Intelligence Unit

ENDS (1999), "Ford & GM Push ISO14001 Down Their Supply Chains", The ENDS Report No. 297 : Environmental Data Services, p39

ENDS (2000), "How Effective are Environmental Management Systems?", The ENDS Report No. 311 : Environmental Data Services, pp 27-29.

ENDS (2001), "Agency Cools on Greater Role for Management Systems under IPPC", The ENDS Report No. 323 : Environmental Data Services, pp 12 – 13.

ENDS (2002), "Tackling a Crisis of Confidence in ISO14001", The ENDS Report No. 327 : Environmental Data Services, pp. 31 – 33.

Ford, D [darren.ford@cips.org], January 5th 2004, RE : *Doctoral Research Feedback*. E-mail to Ian Riggs [iriggs@cosworth-technology.co.uk]

Ford (2001), Q1 - 2002 Setting the Standard [online], Available from http://web.bli.ford.com/q1, (Accessed on December 11th 2001)

Gordon, D. K. (2000), "A Quality System Standard for Aerospace", in ASQ (ed) *Proceedings of the American Society for Quality's 54th Quality Congress*, Milwaukee : American Society for Quality.

GRI (2000), *Sustainability Reporting Guidelines on Economic, Environmental and Social Performance, June 2000*. Boston : Global Reporting Initiative.

Hakes, C. (1999), *The Business Excellence Handbook*, Fifth Edition. Bristol : Bristol Quality Centre Ltd.

Hart, C. (2000), *Doing a Literature Review : Releasing the Social Science Research Imagination,* London : SAGE Publications

Hoyle, D. (1996), "QS9000 – The Differences", *Quality World*, 22 (7) pp 473 – 478.

Hussey, J. & Hussey, R. (1997), *Business Research : A Practical Guide for Undergraduate and Postgraduate Students,* London : Macmillan Business

Hutchins, D. (2001), "Certification – On the Road to Ruin?", Quality World, 27 (12), pp18-20.

Hutchinson, E. (2001), "TL 9000 : Quality Management System Overview", in ASQ (ed) *Proceedings of the American Society for Quality's 55th Quality Congress.* Milwaukee : American Society for Quality.

ISO (1996), *ISO14001 Environmental Management System Standard.* Geneva : International Organisation for Standardisation.

ISO (1999), *ISO / TS 16949 Quality Systems – Automotive Suppliers – Particular Requirements for the Application of ISO9001 : 1994*, Geneva : International Organisation for Standardisation.

ISO (2002), *ISO / TS 16949 Quality Systems – Automotive Suppliers – Particular Requirements for the Application of ISO9000 : 2000*, Geneva : International Organisation for Standardisation.

Johnson, D.M. (2001), "Linking QS9000 to Quality Performance Outcomes", The TQM Magazine, 13 (3), pp 161 – 168

Lapin, L. (1990), S*tatistics for Modern Business Decisions*, 5th edition, San Diego : Harcourt Brace Jovanovich

Leipziger (2001), *SA8000 the Definitive Guide to the New Social Standard,* London : FT Prentice Hall

Perez, M. & Sanchez, A. (2001), "Supplier Relations and Flexibility in the Spanish Automotive Industry", International Journal of Supply Chain Management, 6 (1), p 32

QuEST Forum (2001 (a)), *TL 9000 Quality Management System Requirements Handbook,* Release 3. Milwaukee : American Society for Quality.

QuEST Forum (2001 (b)), *TL 9000 Quality Management System Measurements Handbook,* Release 3. Milwaukee : American Society for Quality.

QuEST Forum (2002), *TL 9000 RRS Fee Structure* [online]. Milwaukee : American Society for Quality. Available from http://questforum.asq.org/public/rrsdocs [Accessed on September 26th 2002].

Reid, R. Dan. (1999), "What They're Saying About Standards", *Quality Progress*, 32 (7) p 32

Rhys, G (1995), "The Motor Industry – A Global Picture", In Proceedings of The Wales Quality Centre's Automotive Day of Excellence Conference October 10th 1995 Chepstow, Treforest : Wales Quality Centre

Richmond, P. [Philip.Richmond@Honda-eu.com], 12th March 2002, RE : Honda UK's Quality Management System Requirements for Suppliers. E-mail to Ian Riggs [iriggs@Cosworth-technology.co.uk]

Riggs, I. (1997), "QS9000 – The Automotive Quality Standard", in *Proceedings Castings Development Centre International Conference 1997.* Alvechurch : Castings Development Centre.

SAI (1999), *Guidance Document for Social Accountability 8000 (SA8000),*

New York : Social Accountability International.

Scapens, R.W (1990), "Researching Management Accounting Practice : The Role of Case Study Methods", British Accounting Review, 22, pp 259 – 281

Scrimshire, D. (2000), "QS9000 Goes International with ISO / TS 16949", in ASQ (ed) *Proceedings of the American Society for Quality's 54th Quality Congress,* Milwaukee : American Society for Quality

Scrimshire, D. (2001), "AS9100 – A Global Takeoff", *Quality World*, 27 (3) pp 30 – 32.

Seddon, J. (2004), "These Checks Don't Prove Anything", Daily Telegraph, May 13th p A10

Seddon, J. (2000), "Under the Influence : Is ISO 9001 : 2000 Stronger?", Quality World, 26 (12), p. 28.

Simon, J. L (1985), *Basic Research Methods in Social Sciences*, Third Edition, New York : Random House

Sousa, R. & Voss, C. (2002), "Quality Management Re-visited : A reflective Review and Agenda for Future Research", Journal of Operations Management, (20) 2002 pp 91 – 109

Sturgeon, T. & Florida, R. (1997), "Research Note : The Globalisation of Automobile Production" IMVP Working Paper, Cambridge, Massachusetts : Massachusetts Institute of Technology p 13

Traylen, H. (1994), 'Confronting Hidden Agendas : Co-operative Inquiry with Health Visitors', in Reason, Peter (ed) Participation in Human Inquiry, London : Sage pp 59 –81

VDA6.1 (1998), *Quality System Audit*, 4th Edition. Frankfurt am Main : Verband der Automobilindustrie e.V.

Walz, J. (2000), "TL 9000 : Quality Management Requirements", in ASQ (ed) *Proceedings of the American Society for Quality's 54th Quality Congress.* Milwaukee : American Society for Quality.

Whitbread, C. (1998), *World Automotive Components : Part 1 – The Industry,* Volume 1, London : The Economics Intelligence Unit, pp 26 - 28

White, J. (2002), *Learning to Measure – Measuring to Learn : The Emerging Nexus of GRI and AA1000S* [online]. London : Accountability. Available from : http://www.accountability.org.uk [Accessed on August 18th 2002].

WMG (2000 a), *Doctor of Engineering : 2000 Handbook*, Warwick : University of Warwick

WMG (2000 b), *Research Methodology : Questionnaire Design & Surveys*, Warwick : University of Warwick

Zeng, A.Z. (2000), "A Synthetic Study of Sourcing Strategies", Industrial Management & Data Systems, 100 (5), pp 219 - 226

Appendix A : Supplier Performance Evaluation Datasheet

SUPPLIER PERFORMANCE EVALUATION DATASHEET

SECTION 1 : ORGANISATION DESCRIPTION

1.1 Supplier Details

1.1.1 Name :
1.1.2. Address :

1.1.3 Telephone :
1.1.4 Fax :
1.1.5 E-mail :
1.1.6 Web-site :
1.1.7 Company Registration Number : DUNS Code :
1.1.8 Business established since :

1.2 Key Contacts

CEO / Managing Director : Name :

Telephone	Fax	e-mail	Mobile

Production / Operations Manager : Name :

Telephone	Fax	e-mail	Mobile

Quality Manager : Name :

Telephone	Fax	e-mail	Mobile

Technical Manager : Name :

Telephone	Fax	e-mail	Mobile

Sales Manager : Name :

Telephone	Fax	e-mail	Mobile

Customer Contact : Name :

Telephone	Fax	e-mail	Mobile

24-Hour Emergency Contact : Name :

Telephone	Fax	e-mail	Mobile

Datasheet compiled by :

Name :	Date :
Position :	
Signature	

1.3 Parent Company / Ownership

When was the business established? :

What is your current ownership? Public Private

Name of Parent Company :

1.4 Organisation Overview

1.4.1 Description of products manufactured :

1.4.2 Production locations :

1.4.3 Industry sectors served :

Sector	% of Turnover

1.4.4 Key customers

Customer Name	% of Turnover

1.4.5 Key markets

Market	% of Turnover
UK	
EEC (excl UK)	
USA	
Asia	
Other	

1.4.6 Number of employees : Group Business Unit :

1.4.7 Floor space : Total area (M^2)

Manufacturing (M^2) :

Land usage : Total available (M^2) : Total used (M^2) :

Attach a plant and facilities layout plan :

1.4.8 Company Turnover :

	Turnover (Euros)	Net profit	Number of employees
2003 (forecast)			
2002			
2001			
2000			
1999			
1998			

Please provide statements for the previous year and the current actual or budget. Also attach a trend chart for previous 5-year growth.

1.4.9 Please name any union affiliations :

1.5 Management Structure

1.5.1 Please include a current organisation chart.

1.5.2 How many employees are there in the following functions ?

	Number	% of Total
Product Design (Incl. R&D)		
Process & Tool engineering		
Material Management		
Quality		
Laboratory		
Production		

1.5.3 Communication

i) What is the main business language of the business :

ii) (if not English) How many English-speaking contacts are there in the following departments?

a. Quality :
b. Logistics :
c. Sales :
d. Management :

iii) What hours of work do these departments operate? :

Will the company report the response to quality and delivery concerns using an 8D format? If not how will it report corrective actions?

1.6 Management System Certification & Customer Approvals

e.g. ISO 9001 : QS9000 : ISO / TS 16949 : ISO 14001 : VDA6.3 : Ford Q1

Certification / Award	3rd Party Org / Customer	Certificate No.	Date Awarded	Score % / Grade

Future Plans for system certification :

SECTION 2 : PROCESS INFORMATION

2.1 Key Process Equipment List

Include information on key process equipment in the table below

Equipment Type	Manufacturer	Model	Age	Capacity / Size	Current Utilisation	Quantity

2.2 Process / Equipment Capability List

State the expected capability (Cpk) for typical significant characteristics using specified tolerances.

The process capability list should also include reference to measurement systems used to verify products such as gauges, fixtures along with an indication of the measurement systems analysis results (Gauge Repeatability and Reproduce-ability (R&R)) for specified tolerances.

Process / Machine	Typical Key Characteristics	Typical Tolerance	Cpk / Cmk / R&R

2.3 Measurement & test

2.3.1 Please complete the laboratory scope for Internal Laboratory facilities.

Equipment Type	Manufacturer	Test Description	Test Specification

2.3.2 Do you have all the equipment and facilities necessary to inspect and test your products, as defined in the control plan?

☐ Yes ☐ No

If NO, what measurements or tests are subcontracted?

Test Description	Laboratory / Subcontractor	ISO17025 * Approved

*or National equivalent ***(include copies of certificates).***

2.4 What are the shift patterns in operation?

2.5 Is there a Preventative Maintenance Plan in place for all key equipment listed?

☐ Yes ☐ No

2.6 Tooling & Development

Do you have :

Toolroom?	☐ Yes	☐ No
Tool design facilities?	☐ Yes	☐ No
Tool makers?	☐ Yes	☐ No
How Many ?		
Prototype facilities	☐ Yes	☐ No

If NO can you subcontract prototype manufacture? ☐ Yes ☐ No

2.7 CAD-CAM facilities? ☐ Yes ☐ No

If Yes, what type of equipment and data transfer?

2.8 Logistics

2.8.1 What barcode system do you currently use?

Could you change to another one? ☐ Yes ☐ No

2.8.2 What EDI tools are available?

Schedules	☐ Yes	☐ No
Delivery documents	☐ Yes	☐ No
Invoices	☐ Yes	☐ No
Are they VDA / Edifact compatible?	☐ Yes	☐ No

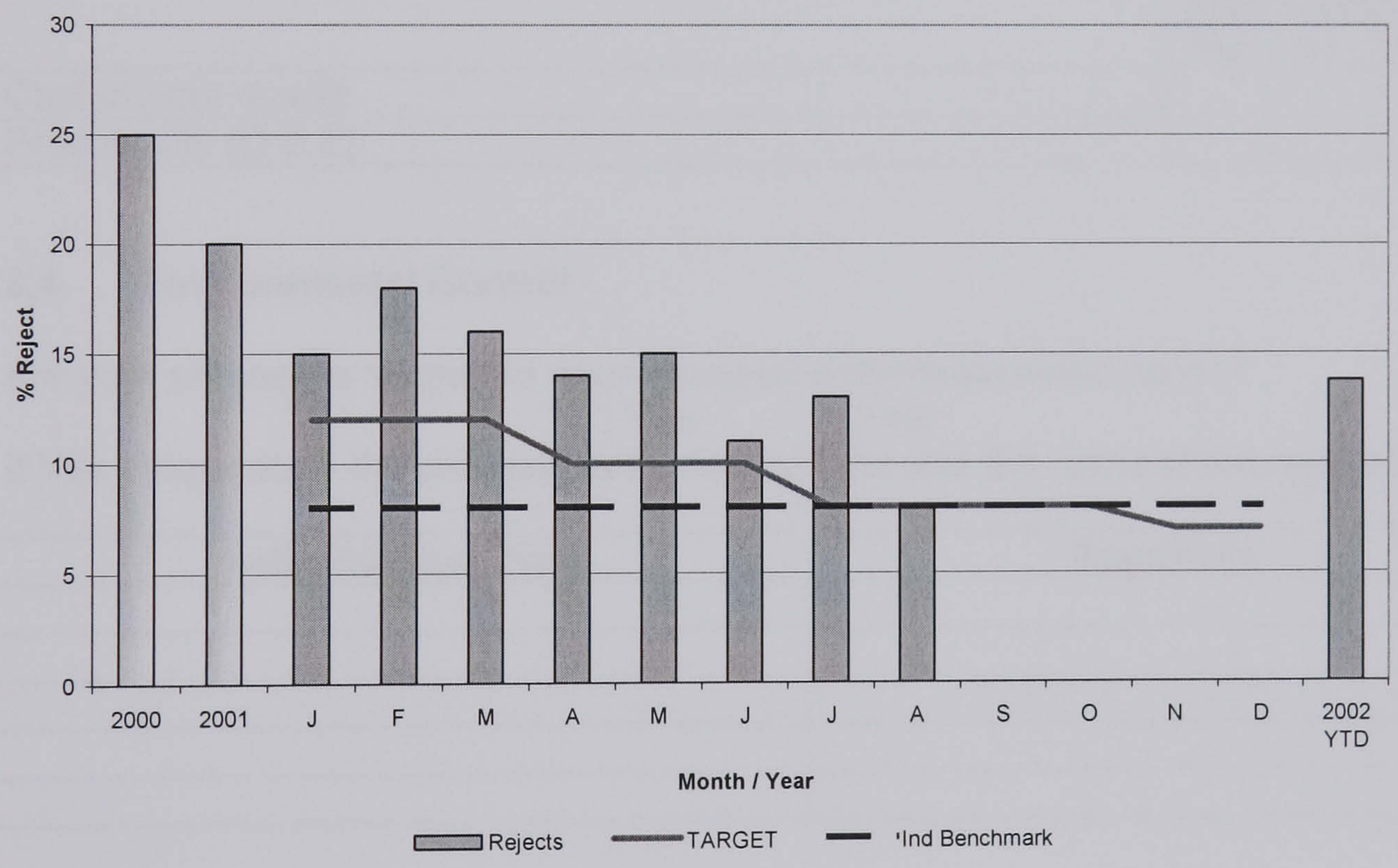
SECTION 3 : KEY PERFORMANCE INDICATORS

The purpose of this section is to demonstrate the current business performance of the organisation. Trend data should cover the previous three years with the previous 12 months shown per month and preceding two years as annual figures, as shown in the figure on the following page.

Where known industry benchmarks should also be included.

The following data is required on products relevant to the customer. Data may be shown as an overall average of products of the same type or by individual part number.

Product Internal Quality Trend Graph



3.1 Quality Metrics

	Data Included		
	Yes	No	N/A
Overall external quality performance by product type (PPM) trend			
Overall internal quality performance by product type (PPM) trend			
Number of customer quality discrepancies in last 12 months			
% of repeat customer quality discrepancies in past 12 months			
External rework performance by product type (PPM) trend			
Internal rework performance by product type (PPM) trend			
Overall supplier quality performance (PPM) trend			
Warranty performance by product type trend			
External Quality Audit Results (Nonconformities)			

3.2 Delivery Metrics

	Data Included		
	Yes	No	N/A
Overall delivery performance (% on time)			
Supplier delivery performance			

3.3 Other Performance Indicators

	Data Included		
	Yes	No	N/A
Cost of poor quality			
Productivity (O.E.E)			

3.4 Environmental Control

Are your processes subject to environmental authorisations/consents?

☐ Yes ☐ No

If Yes please state the process, authorisation type and the name of the regulator.

Authorisation Type	Regulator

SECTION 4 : CUSTOMER REFERRALS

Please provide the names of customer contacts (minimum of 2 and which make up more than 40% of business) that can confirm the details of product quality and delivery performance provided within this report.

We will contact the customer directly to complete the ***Customer Satisfaction Evaluation Datasheet*** (see next page for example datasheet).

Customer One

Company Name :
Location :
Products Supplied :
% of turnover :

Performance Data for Past 12 Months

Quality PPM :
No. of quality discrepancies :
Delivery Performance (% on time) :
No. of delivery discrepancies :

Purchasing Contact :

Name :
Position :
Telephone :
Fax :
e-mail :

Quality Contact :

Name :
Position :
Telephone :
Fax :
e-mail :

Customer Two

Company Name :
Location :
Products Supplied :
% of turnover :

Performance Data for Past 12 Months

Quality PPM :
No. of quality discrepancies :
Delivery Performance (% on time) :
No. of delivery discrepancies :

Purchasing Contact :

Name :
Position :
Telephone :
Fax :
e-mail :

Quality Contact :

Name :
Position :
Telephone :
Fax :
e-mail :

Customer Satisfaction Evaluation Datasheet

Customer Name : **Date :**
Location :

Purchasing Contact : **Position :**

Quality Contact **Position :**

Contact Telephone No. : **e-mail :**

Products supplied by Supplier :

Quality Performance (PPM or %) for past 12 months :

Quality performance (number of discrepancies) for past 12 months :

Delivery Performance (adherence to schedule %) for past 12 months :

Delivery Performance (number of discrepancies) for past 12 months :

To be completed by the Customer

Customer confirmation of performance data : **YES** **NO**

Please rate the supplier on the following categories, where :

1= Poor, 2 = Needs Improvement, 3 = Satisfactory, 4 = Good, 5 = Excellent

	Place a tick below, based upon your opinion				
Project Management	**1**	**2**	**3**	**4**	**5**
In terms of Project Management how do you rate this supplier?					
How do they compare with your other suppliers?					
How could this supplier improve their Project Management Processes?					

Technical Ability	**1**	**2**	**3**	**4**	**5**
In terms of Technical Ability how do you rate this supplier?					
How do they compare with your other suppliers?					
What improvements could the supplier make to improve their Technical Ability?					

Quality	**1**	**2**	**3**	**4**	**5**
In terms of Quality Management how do you rate this supplier?					
How do they compare to your other suppliers?					
What improvements would you like to see the supplier make in terms of their quality management processes?					

Delivery	1	2	3	4	5
In terms of Delivery & Logistics how do you rate this supplier?					
How do they compare to your other suppliers?					
Are there any changes that you would like to see this supplier make in relation to its delivery processes?					

Attitude	1	2	3	4	5
In terms of Attitude how do you rate this supplier?					
How do you rate their communication ability?					
How do they compare to your other suppliers?					
How could this supplier improve its relationship with you?					

General	1	2	3	4	5
What is your overall perception of this supplier?					
How do they compare against other suppliers of this type of product?					
How does the supplier's overall performance compare with last year? ☐ Improved ☐ About the same ☐ Worse					
Are there any other comments you would like to make regarding this supplier's performance?					

APPENDIX B : Supplier Performance Evaluation Scoring Spreadsheet

Example

SUPPLIER PERFORMANCE EVALUATION

Supplier : ACME Ltd
Team : IR, MI, JG, AB

Date : February 2nd 2004
Overall Evaluation Score % : 71%

Ref	Element	Minimum Requirements	Actual result	Priority Rating (0-10)	Performance Rating (0-10)	Element Score	Comments
2	**Process capability**						
2.1	Management system certification	ISO / TS 16949	ISO 9000 : 2000	10	6	60	
2.2	Key equipment list	> 85% utilisation	>90%	8	4	32	
2.3	Process capability						
	Cu	1.33 Cpk	1.75	8	8	64	
	Ni	1.33 Cpk	1.9	8	8	64	
	Fe	1.33 Cpk	2.1	8	8	64	
	Si	1.33 Cpk	1.84	8	8	64	
	Cleanliness	1.33 Cpk	3.1	8	8	64	
	Spectrograph Gauge R&R	25% for CT spec tolerances	9%	8	8	64	
2.4	External laboratories	ISO 17025 approved	n/a	0	0	0	
2.5	Internal laboratory scope	Includes Spectograph & cleanliness testing methods	Spectorgraph but no cleanliness test method	8	4	32	
3	**Performance Indicators**						
3.01	External PPM	1%	1.70%	6	4	24	
3.02	Internal PPM	5%	4.40%	8	8	64	
3.03	Quality Discrepancies	12	6	8	8	64	
3.04	Repeat Discrepancies	10%	12%	8	6	48	
3.05	External rework	n/a	n/a	0	0	0	
3.06	Internal rework	10%	5.65%	4	8	32	
3.07	Supplier PPM	3%	5%	6	4	24	
3.08	Warranty PPM	0.10%	0.03%	8	10	80	
3.09	Delivery % on time	98%	99%	8	8	64	
3.10	Supplier delivery performance	98%	96%	6	6	36	
3.11	Cost of poor quality	n/a	No data	0	0	0	
3.12	Productivity (O.E.E)	60%	72%	6	8	48	
4	**Customer referrals**	50%	70%	10	8	80	

Appendix C : Expert Opinion Survey Questionnaire

Supplier Performance Evaluation Process
Expert Opinion Survey

Autumn 2003

Name : Position :

Company :

Tel :

e-mail :

Number of years in Industry? : Current Position? :

Please note that this process is intended for potential suppliers to the organisation and NOT current suppliers.

Question 1

Does your organisation specify 3rd Party certification for its supply base?

Yes : No :

If 'Yes' please specify :

ISO 9001 : QS 9000 / TS 16949 : Other :

If Other, please specify :

Question 2

Does your organisation conduct 2nd party audits on potential suppliers?

Yes : No : Sometimes :

2 (a) If 'Sometimes' please specify the criteria used to decide if an audit is required:

2 (b) If 'Yes' what standard is used ;

ISO9001 : QS9000/TS16949 : VDA6.3 :

Other (please specify) :

Question 3

Does your organisation currently review detailed quality, delivery and operational performance data of potential suppliers before the supplier selection decision is made?

Yes : No :

If 'Yes' please describe the process and the metrics reviewed :

Question 4

Section 2 of the Supplier Performance Evaluation Datasheet is designed to determine the current supplier capability and capacity of its key processes, including measurement and outsourcing.

4.1 Please rate each element for its relevance to the supplier selection process.

Element	Vital	Important	Useful	Some Use	No Use
Process Utilisation / Capacity					
Typical Capability Values					
Typical Gauge Capability Values					
Laboratory Scope					
External Processing					
External Laboratories					

4.2 What additional process capability information do you think should be included?

Element	Vital	Important	Useful	Some Use	No Use

4.3 Do you have any comments to make on this section of the Supplier Performance Evaluation Datasheet? (Please use additional pages if necessary)

Question 5

Section 3 of the Supplier Performance Evaluation Datasheet requires the supplier to provide trend data for key quality, delivery and operational metrics. The list of metrics has been determined from a review of those required by ISO / TS 16949 and from interviews with purchasing and quality professionals.

5.1 Please review the list of metrics included in section 3 and rate their importance.

Element	Vital	Important	Useful	Some Use	No Use
External quality (PPM)					
Internal quality (PPM)					
No. of quality concerns					
No of repeat concerns					
External rework (PPM)					
Internal rework (PPM)					
Cost of poor quality (£)					
Sub supplier quality (PPM)					
Quality certification audit results					
Warranty performance (PPM)					
Delivery performance (%)					
Sub supplier delivery performance (%)					
Productivity (O.E.E)					

5.2 Are there any additional metrics that you believe are important to the supplier selection decision?

Element	Vital	Important	Useful	Some Use	No Use

5.3 Do you have any comments to make on this section of the Supplier Performance Evaluation Datasheet? (Please use additional pages if necessary)

Question 6

Section 4 of the Supplier Performance Evaluation datasheet requires the potential supplier to nominate at least 2 current customers that can be contacted to provide a referral and confirm the supplier's quality and delivery performance. Typically these two customers should be a minimum of 40% of the supplier's turnover.

Please review the example customer questionnaire provided and rate the following sections.

Element	Vital	Important	Useful	Some Use	No Use
Confirmation of performance data					
Project management					
Technical ability					
Quality management					
Delivery performance					
Attitude & communication					
General performance					

6.2 Are there any other topics that you believe should be included in this questionnaire?

Element	Vital	Important	Useful	Some Use	No Use

6.3 How effective do you believe that this mechanism would be in validating the key performance metrics?

Very effective	Somewhat effective	Don't know	Of little effect	Not Effective

6.4. On a scale of 1 – 10, rate how practical do you believe that the Customer Questionnaire process would be to carry out (where 10 is very practical and 1 is not practical) :

6.4.1 By the potential customer?

6.4.2 By the potential supplier?

6.4.3 By the current customer?

6.5 Do you have any comments to make on this section of the Supplier Performance Evaluation Datasheet? (Please use additional pages if necessary)

Question 7

How would you rate the ease of use and usefulness of the Supplier Performance Evaluation process?;

7.1 Ease of use

Very Easy	Easy	Don't know	Not very easy	Not easy

7.2 Usefulness

Very useful	Useful	Don't know	Limited use	No use

7.3 Would this process add value to your current supplier selection process? Please delete the appropriate response below and add any comments that you wish to make.

Yes : No :

Comments :

Thank You for completing this Questionnaire. Please e-mail this questionnaire to the researcher using the address shown.

Do not forget to attach the questionnaire file to the e-mail.

i.riggs@btinternet.com